FORENSIC CHEMISTRY DRUG TRAINING PROGRAM

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Introduction

Purpose

The purpose of this manual is to provide uniform training for entry-level forensic drug chemists in order to maintain the performance of the laboratory. Quality training also plays a role in the obligation to provide reliable results to customers. The goal of training a new chemist is to develop the knowledge of drugs and their properties and develop their skills and abilities in wet chemistry and instrumental analysis. This work follows SWGDRUG and ENFSI guidelines for training to maintain a standard of professional competency.

Training will be conducted through listed readings, one-on-one instruction, online resources, study questions, and practical exercises. Listed references are not intended to be exhaustive, and may be expanded or abridged as necessary. Assessments of competency upon completion of modules will include written and/or oral exams, and a formal mock trial. (ASCLD/LAB 5.2.5)

Training should culminate so that the trainee has the following:

- Knowledge of the basic chemistry, scheduling and penalties of controlled substances;
- Knowledge of the procedures and practices of forensic analytical chemistry related to the analysis of controlled, dangerous, or commonly abused substances;
- Knowledge of the theory and applications of the various instruments and specialized techniques used to analyze controlled substances;
- Ability to perform accurate forensic analysis independently and proficiently; and
- Ability to skillfully present and defend analytical findings in courts of records.

Program Objectives

Trainees are expected to advance their knowledge of drug chemistry through training and continuing professional development. Trainees are expected to participate fully in the training program in order to learn the material presented. Performance goals should be clarified for each module assignment and/or assessment. Upon approval for independent casework, analysts are encouraged to gain membership in professional organizations in order to maintain awareness of and share new or improved analytical techniques and emerging trends.

This program aims to give the trainee information on the topics below in order to successfully provide technical and scientific support.

- Background on drugs of abuse (e.g. control status, chemical and physical characteristics)
- Evidence handling procedures (safety and security, sampling, uncertainty, LIMS)
- Evidence analysis (techniques, methodologies, instrumentation)
- Quality Assurance
- Clandestine laboratory investigations
- Ethics
- Court testimony

In order to guide the trainee through the training program and ensure that the material is thoroughly covered and understood, there are various modes of instruction, references, and assessments included in the outline.

Coordination of the Program

The Technical Leader will act as training coordinator of the drug training program and is responsible for the overall training. Qualified chemists may conduct certain duties or blocks of instruction at the direction of the training coordinator. An individual with demonstrated

competence in the subject area and in the delivery of training is qualified to conduct training. External training must be arranged through and approved by the supervisor.

Training Period

The length of training period will be left to the discretion of the training coordinator. Generally, training will be no less than four (4) months and may be as many as nine (9) months. The training schedule in Appendix A outlines training topics to be covered. A record will be maintained which will detail training completed, progress made, and areas that need improvement. Although it's not considered part of the training program, continuing professional development should be ongoing.

Overview

There are two major divisions of training in drug analysis. The first division is marihuana identification. Marihuana identification requires the chemist to use the stereomicroscope to identify the physical characteristics of the marihuana plant, and some chemistry techniques to distinguish the cannabinoid alkaloids present in the plant.

The second division of drug training involves other types of drug samples consisting of powders, liquids, pharmaceutical samples, clandestine tablets and capsules, clandestine lab liquids and solids, chemicals, plant materials, and drug paraphernalia. There are volumes of literature and articles pertaining to the identification of drugs, and the chemist should keep abreast of new techniques and methods as they are published.

Drug identification may involve the use of color producing spot tests or screening tests. Each of these tests is extremely important and will be used extensively by the drug chemist.

The instruments that are routinely used in drug analysis are the ultraviolet spectrophotometer, infrared spectrophotometer, gas chromatograph, and gas chromatograph/mass spectrometer (GC/MS). Each of these instruments play an important role in drug identification and the chemist must become familiar with the operation, maintenance, calibration, and scientific principles of each.

The most difficult part of drug analysis training involves the isolation of the drug to be identified. On most occasions, samples to be analyzed are impure. Very often the chemist must isolate the compound of interest, and then use the proper instrumentation to conclusively identify the substance. Training may include techniques used for isolating drugs such as acid/base wet chemical extractions, thin-layer chromatography, and column chromatography.

The Trainee will also receive training on the fundamentals of evidence security, procedures used for evidence handling, and proper worksheet documentation.

Structure and Curriculum

The training program is organized so that the trainee will gain a background of drugs, a reinforcement of general chemistry concepts, marihuana identification, drug analysis, and courtroom testimony. It is broken into two phases: marihuana analysis and drug analysis.

The training program covers a curriculum including but not limited to the following core topics (Decide which will require exams and documentation):

- Drugs of Abuse
- General Chemistry
- Basic Lab Skills
- Solubility and Extractions
- Microscopy
- Spectrophotometry (Ultraviolet and Infrared)
- Chromatography
- Mass Spectrometry

- Chemical Characterization
- Mathematics and Statistics
- Courtroom Testimony

Training will also include specific laboratory practices such as proper evidence handling and the use of the Laboratory Information Management System (LIMS).

(Structure the Training Program to follow the City of Austin Training Record.)

Each module includes objectives for learning, definitions, and related literature references to guide the trainee through the material. Modes of instruction may include any combination of listed readings, one-on-one instruction, online resources, demonstrations, and practical exercises of known and unknown samples. Assessments of competency for each module may include study questions, analysis of known and unknown samples, and written and/or oral examinations. ***(ASCLD/LAB 5.2.5)***

Throughout the training period, the trainee will assist with casework; only under the direct supervision of a qualified examiner to familiarize the trainee with different forms of case evidence, packaging, applied analytical techniques and note-taking.

Add statement for structure of training. ASCLD/LAB wants to see curriculum, tests taken as a demonstration of training, skills and experience. ***ASCLD/LAB 5.2.5***

A written competency examination will be conducted following the successful completion of the marihuana and drug analysis blocks of instruction. Case samples will be selected to evaluate the trainee's competency in applying techniques and procedures to mock casework samples. A mock trial will be arranged using the mock case analysis and results.

If the trainee cannot successfully complete the required modules, assessments, and examinations given during training, then steps must be taken to effect appropriate action. If, after additional training, the trainee is unable to pass the evaluations, then a review of the performance must be done with disciplinary action up to and including termination. *(ASCLD/LAB 5.2.1.1 states procedures are needed for retraining and maintenance of skills and expertise.)*

Assessments and Documentation

The progress and completion of each module will be documented on the City of Austin HR Individual Career Progression **Training Record**. The trainee's successful completion of a competency test will be recorded on the Division Employee Authorization **Form**; the written examinations may be kept by the trainee for reference purposes. The trainer will maintain written evaluations of the trainee throughout the training period, including areas that may need improvement. This feedback should be made available to the training coordinator for review. Upon completion of the written competency examinations for marihuana and drug analysis, the trainee will be **authorized** by the Laboratory Director to perform supervised casework in the applicable area(s) of analysis. The trainee will be **authorized** for independent casework in these areas after the final mock trial. *(ASCLD/LAB 5.2.5)* At that point, the analyst may have independent access to unsealed evidence to separate and analyze samples, compile data, and produce reports for court or investigative purposes.

Professional Development

Analysts should continue their professional development by aiming to complete at least twenty hours of training every year. Acceptable forms of training include (SWGDRUG 3.4):

- Chemistry or instrumental courses at post-secondary education level
- Instrument operation or maintenance courses taught by vendors
- In-service classes conducted by the employer
- Current literature review
- In-service training taught by external provided (e.g. DEA Forensic Chemist Seminar)

- Clandestine Laboratory Safety Certification training and subsequent annual renewal course
- Participation in relevant scientific meetings or conferences (e.g. delivering oral or poster presentation, attending a workshop, providing reports on conferences)

Additionally, membership in regional or national forensic organizations is encouraged, and certification by the American Board of Criminalistics is desirable.

Introduction

This section of the training will focus on the structures, properties, and ~~basic pharmacology~~ of drugs of abuse…

1. Drug Chemistry Overview

1.1. Objectives

1.1.1. Learn the major drug classes
1.1.2. Learn the nomenclature including lawful and street names
1.1.3. Learn the chemical and legal classifications of drugs
1.1.4. Molecular structures of the most commonly abused drugs as well as relationship of isomers, analogues, homologues, and derivatives
1.1.5. Natural, semi-synthetic and synthetic sources of drugs
1.1.6. Classification of drugs as acids, neutrals, and bases
1.1.7. Simple pharmacology of the major classes of drugs
1.1.8. Solubility and salt forms

1.2. Modes of Instruction

1.2.1. Recommended reading
1.2.2. Study questions (oral, written)
1.2.3. Demonstrations of samples
1.2.4. Discussion and clarification of questions

1.3. References

1.3.1. Drug Enforcement Administration. (2011). *Drugs of Abuse*. Washington, DC: U.S. Department of Justice. http://www.justice.gov/dea/docs/drugs_of_abuse_2011.pdf
1.3.2. United Nations Office of Drug Control. (2003). *Terminology and Information on Drugs* (United Nations Publication No. E.03.XI.4). New York: NY: United Nations. http://www.unodc.org/pdf/publications/report_2003-09-01_1.pdf
1.3.3. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.
1.3.4. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.
1.3.5. Bell, S. (2006). *Forensic Chemistry*. Upper Saddle River, NJ: Pearson Education, Inc.
1.3.6. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.
1.3.7. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.
1.3.8. Shulgin, A., & Shulgin, A. (1991). *PiHKAL: A Chemical Love Story*. Berkeley, California: Transform Press.
1.3.9. Inaba, D., & Cohen, W. (2007). *Uppers, Downers, and All Arounders*. Medford, OR: CNS Publications, Inc.
1.3.10. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.
1.3.11. Martindale The Extra Pharmacopoeia (Reynolds) - Verify
1.3.12. Beers, M., & Berkow, R. (Ed.) (1999). *The Merck Manual of Diagnosis and Therapy*. Whitehouse Station, NJ: Merck Research Laboratories.

1.4. Assessment

1.4.1. Oral and/or written examination
1.4.2. Courtroom exercise (final mock trial)

2. Legislation

2.1. Objectives

2.1.1. Learn the penalty groups for controlled substances in Texas
2.1.2. Learn the schedules for controlled substances in Texas
2.1.3. Become familiar with the Federal Analog Act of 1986

2.2. Modes of Instruction

2.2.1. Self-directed study through recommended reading
2.2.2. Discussion, Clarification of questions

2.3. References

2.3.1. Texas Controlled Substance Act can be found in Health and Safety Code Title 6. Food, Drugs, Alcohol, and Hazardous Substances Subtitle C. Substance Abuse Regulation and Crimes Chapter 481- 485.
2.3.2. Drug Enforcement Agency, Controlled Substances by Alphabetical Order, retrieved from www.deadiversion.usdoj.gov/schedules/alpha/alphabetical.htm
2.3.3. U.S. Controlled Substance Act, Title 21 Chapter 13 found at www.usdoj.gov/dea/pubs/csa.html
2.3.4. Drug Enforcement Agency, Controlled Substance Analogue Enforcement Act of 1986, retrieved from http://uscode.house.gov/download/pls/21C13.txt
2.3.5. Federal Analog Act of 1986, retrieved from http://www.erowid.org/psychoactives/law/law_fed_analog_act.shtml
2.3.6. USA v. Damon S. Forbes (1992), AET is determined not to be an analog of DET and DMT, retrieved from http://www.erowid.org/psychoactives/law/cases/federal/federal_analog1.shtml
2.3.7. United States vs. Nicolas Sand and Robert Timothy Scully (1976), *Court ruling ALD-52 was determined to be analog of LSD*, retrieved from http://openjurist.org/541/f2d/1370/united-states-v-sand

2.4. Assessment

2.4.1. Mock casework
2.4.2. Oral and/or written examination
2.4.3. Courtroom exercise (final mock trial)

2. Cannabis

2.1. Objectives

2.1.1. Description of the cannabis plant including names and synonyms, botany, physical appearance, morphological, microscopic and chemical characteristics, herbal products, cannabis resin, and liquid cannabis)
2.1.2. Cultivation of cannabis plant (indoor/outdoor/industrial production, harvesting, yield)
2.1.3. Production of illicit cannabis products (herbal/resin/liquid cannabis)
2.1.4. Pharmacology of cannabis products
2.1.5. Legal aspects including state and federal
2.1.6. Familiarity with Cannabis Receptor Agonists (cannabinomimetic compounds, e.g. 'spice' products), including legal aspects
2.1.7. Familiarity with the protocol (tech manual) for the analysis of illicit cannabis products (including sampling, physical examination, microscopy, extraction, color tests, GC/MS, LC/MS, analytical challenges, and special pitfalls)
2.1.8. Ability to perform identification of marihuana

2.2. Modes of Instruction

2.2.1. Self-directed study through recommended reading
2.2.2. Preparation of samples and of analysis by trainer, with explanations
2.2.3. Interpretation of results and discussion including limitations
2.2.4. Application of qualitative analysis on known samples by trainee
2.2.5. Application of qualitative analysis on unknown samples by trainee
2.2.6. Discussion, Clarification of questions

2.3. References

2.3.1. Drug Enforcement Administration. (2011). *Drugs of Abuse*. Washington, DC: U.S. Department of Justice. http://www.justice.gov/dea/docs/drugs_of_abuse_2011.pdf

2.3.2. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

2.3.3. "Training Manual on Drugs", Texas Dept. of Public Safety Crime Laboratory.

2.3.4. Moffat, A.C. editor. *Clarke's Isolation and Identification of Drugs*. London: The Pharmaceutical Press, 1986, pp.423-425.

2.3.5. Nicar, M.J., "Marihuana Use and Abuse", Chemistry, Vol. 52, No.1, Jan. 1979.

2.3.6. "Marihuana, Hashish, and Hashish Oil", California Dept. of Justice Training Center, Feb. 1979.

2.3.7. Manual on the cultivation of Cannabis (Europol, June 2000)

2.3.8. Clandestine Laboratory Guide for Agents and Chemists (DEA)

2.3.9. Small, E., "American Law and the Species Problem in Cannabis: Science and Semantics", Bulletin on Narcotics, Vol.XXVII, No.3, July 1975. http://www.unodc.org/unodc/en/data-and-analysis/bulletin/bulletin_1975-01-01_3_page002.html

2.3.10. United Nations Office on Drugs and Crime. (2009). *Recommended methods for the identification and analysis of cannabis and cannabis products* (UNODC ST/NAR/40). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/documents/scientific/ST-NAR-40-Ebook.pdf)

2.3.11. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html)

2.3.12. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

2.3.13. Analysis of Drugs Manual (DEA)

2.3.14. The Analysis of Controlled Substances (Cole, Wiley)

2.3.15. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.

2.3.16. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/documents/scientific/Drug_Sampling.pdf)

2.3.17. **Nakamura, George R. and Thorton, John I. "The Identification of Marijuana" Journal of the Forensic Science Society, (1972), 12, 461.**

2.3.18. Nakamura, G.R. and Thornton, J.I., "The Forensic Identification of Marihuana: Some Questions and Answers", Journal of Police Science Administration, Vol.1, 1973.

2.3.19. Young, J James L., "Tests for Marihuana", Alcohol Tax Unit, Internal Revenue Service. 1951.

2.3.20. Butler, W., "Methods of Analysis for Alkaloids, Opiates, Marihuana, Barbiturates, and Miscellaneous Drugs", U.S. Department of Justice, Publication, No. 341.

2.3.21. AOAC Methods (1980) Section 40.012 and 40.013 (page 686)

2.3.22. Joyce, C.R.B, &Curry, S.H. (1970). *The Botany and Chemistry of Cannabis.* London: J. & A. Churchill.

2.3.23. Stearn, W.T., "Typification of Cannabis Sativa L.", Botanical Museum Leaflets, Harvard University, Vol.23, No.9, Feb. 1974.

2.3.24. Nakamura, G.R., "Forensic Aspects of Cystolithic Hairs of Cannabis and Other Plants", Journal of the AOAC, Vol.52, No.1, 1969.

2.3.25. Quimby, M.W., Et.Al. "Mississippi-Grown Marihuana- Cannabis Sativa Cultivation and Observed Morphological Variations", Economic Botany, Vol.27, No.1, Jan. 1973.

2.3.26. Johns, S.H., Wist, A.A., and Najam, A.R., "Spot Tests: A Color Chart Reference for Forensic Chemists", Journal Forensic Sciences.

2.3.27. Maunder, M.J. de Faubert, "Two Simple Color Tests for Cannabis", Bulletin on Narcotics, Vol.XXI, No.4, Oct. 1969.

2.3.28. Pitt, C.G., and Hendron, R.W., and Hsia, R.S., "The Specificity of the Duquenois Color Test for Marihuana and Hashish", Journal of Forensic Science, 1972.

2.3.29. Bailey, K. "The Value of the Duquenois Test of Cannabis – A Survey: Journal for Forensic Science, (1971), 24(4), pp.817-841.

2.3.30. Hughes, R.B. and Warner, V.J., "A Study of False Positives in the Chemical Identification of Marihuana", Journal of Forensic Sciences, Vol.23, No.2, April 1978.

2.3.31. Brief Note on the Response of Some Essential Oils and Extracts of Vegetable Origin to the Duquenois-Levine Test for Cannabis (JFS, 1971)

2.3.32. Hughes, R.B. and Kessler, R.R., "Increased Safety and Specificity in the Thin Layer Chromatographic Identification of Marihuana", Journal of Forensic Sciences, Vol. 24, No. 4, Oct. 1979.

2.3.33. Buel, E., Plum, C.N., and Frisbie, S.K., "Partition Thin-Layer Chromatography System for the Identification of Cannabinoids", Microgram, Vol. XV, No. 9, Sept.1982.

2.3.34. Grlic, L., "Recent Advances in the Chemical Research of Cannabis", Bulletin on Narcotics, Vol.XVI, No.4, Oct.1964.

2.3.35. Farnsworth, N.R., "Pharmacology and Chemistry of Cannabis Sativa", Journal of the American Pharmaceutical Association.

2.3.36. Forensic Chemistry Section, Procedures Manual, Analysis Notes: Marihuana

2.3.37. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

2.3.38. The Merck Index

2.3.39. Microgram, Vol.VII, No.2, Feb. 1974.

2.3.40. “Understanding the ‘Spice’ phenomenon” (EMCDDA, 2009)

2.3.41. “Synthetic cannabinoids and Spice” (EMCDDA)

2.4. Assessment

2.4.1. Written examination
2.4.2. Preparation of samples and reagents (practical)
2.4.3. Distribution and application of analysis on unknown samples (practical)
2.4.4. Courtroom exercise (mock trial, optional)

3. Amphetamine Type Stimulants (ATS)

3.1. Objectives

3.1.1. Learn the classification and respective definitions
3.1.2. Learn the description of compounds, physical and chemical characteristics, stereochemistry
3.1.3. Become familiar with non-ring substituted amphetamines (e.g. amphetamine, methamphetamine, cathine, cathinone, methcathinone, fenetylline)
3.1.4. Become familiar with methylenedioxy- substituted amphetamines (e.g. MD, MDMA, MDEA, FLEA, MBDB)
3.1.5. Become familiar with other ring substituted amphetamines (also in section "Hallucinogens")
  3.1.5.1. – 2,4,5-ring substituted phenethylamines (e.g. 2C-B, 2C-T, WC-T-2, 2C-T-7, 2C-C, 2C-I)
  3.1.5.2. – 2,4,5-ring substituted amphetamines (e.g. TMA-2, STP/DOM, DOB, DOC, DOI, DOET)
  3.1.5.3. Other ring substitution patterns (phenethylamines and amphetamines) (e.g. Mescaline, PMA, PMMA, DMA, TMA, 4-MTA)
3.1.6. Learn the illicit ATS manufacture, including the synthesis of amphetamine, methamphetamine, and rung-substituted ATS (e.g. XTC, etc)
3.1.7. Learn the pharmacology of ATS
3.1.8. Learn the legal aspects concerning ATS in state and national legislation
3.1.9. Become familiar with the protocol for the analysis of ATS (including sampling, physical description, extraction, presumptive (color) tests, optical isomer analysis, TLC, GC/MS, LC/MS, FTIR, analytical challenges, special pitfalls)
3.1.10. Become familiar with additional analytical techniques for the analysis of ATS
3.1.11. Perform identification of ATS in illicit materials
3.1.12. Perform quantification of ATS in illicit materials

3.2. Modes of Instruction

3.2.1. Self-directed study through recommended reading
3.2.2. Study questions
3.2.3. (Clarification of questions)
3.2.4. Preparation of samples and of different reagents necessary for the analysis including review of safety precautions
3.2.5. Demonstrations of samples and of analysis by trainer, with explanations
3.2.6. Interpretation of results and discussion including limitations
3.2.7. Practical exercises (Application of qualitative/quantitative analysis on known samples of ATS by trainee & Application of qualitative/quantitative analysis on unknown samples of ATS by trainee)
3.2.8. Discussion

3.3. References

3.3.1. "Terminology and Information on Drugs", UNODC, E.03.XI.14 ISBN 92-1-148163-5, September 2003(LINK)

3.3.2. "Recommended Methods for the Identification and Analysis of Amphetamine, Methamphetamine and their Ring-substituted Analogues in Seized Materials", UNODC, ST/NAR/34, January 2006(LINK)

3.3.3. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html

3.3.4. “Colour tests for precursor chemicals of Amphetamine-Type Substances: The use of colour tests for distinguishing between Ephedrine-Derivatives”, UNODC, SCITEC/20, December 2005(LINK)

3.3.5. “Colour tests for precursor chemicals of amphetamine-type substances: Systematic study of colour tests for safrole and safrole-rich essential oils”, UNODC, SCITEC/21, December 2007(LINK)

3.3.6. “Clandestine Manufacture of Substances under International Control”, UNODC, ST/NAR/10/Rev.2, August 1998 (LINK)

3.3.7. “Multilingual Dictionary of Narcotic Drugs and Psychotropic Substances Under (LINK)

3.3.8. International Control (MLD)”, UNODC, ST/NAR/1/rev.2, December 2006 (LINK)

3.3.9. “A practical guide to methamphetamine characterization/impurity profiling: Method procedures, mass spectral data of selected impurities, and literature reference”, UNODC, SCITEC/17, August 2000 (LINK)

3.3.10. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

3.3.11. “Analysis of Drugs Manual”, United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

3.3.12. Clarke, E. G. C. (2004). *Clarke’s Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

3.3.13. “The Analysis of Controlled Substances”, Michael.D. Cole, John Wiley & Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

3.3.14. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.

3.3.15. Shulgin, A., & Shulgin, A. (1991 / 1995). *PiHKAL: Phenethylamines I have Known and Loved: A Chemical Love Story*. Berkeley, California: Transform Press. (http://www.erowid.org/library/books_online/pihkal/pihkal.shtml)

3.3.16. “Clandestine Laboratory Guide for Agents and Chemists”, U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology

3.3.17. “Psychotropic Substances of the Amphetamine Type used by Drug Addicts in Bulgaria - Synthesis and Medicinal Forms Analytical Methods of Identification”, UNODC, SCITEC/10, September 1994 (LINK)

3.3.18. “Characterization / impurity profiling of methamphetamine tablets in South-East Asia”, ONCB/Thailand, Japanese National Police Agency, Japan International Cooperation Agency, UNODC, 2004.

3.3.19. “Studies on Fenetylline, Part I: Selected Methods for Identification in Illicit Samples”, UNODC, SCITEC/8, October 1990

3.3.20. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

3.3.21. “The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals”, O'Neil, Maryadele J. et al, 14th Edition, 2006, 2009 by Merck & Co., Inc., Whitehouse Station, New Jersey, USA (LINK)

3.3.22. “Rapid and sensitive technique for the differentiation of the optical isomeric forms of methamphetamine and amphetamine”, Cunningham, M. D. (1973). Microgram, vol. 6, No. 6, pp. 87-95

3.3.23. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

3.3.24. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

3.3.25. "The Pharmacological Basis of Therapeutics", Goodman & Gilman's, New York, 11/E, 2006, McGraw-Hill

3.4. Assessment

3.4.1. Study questions (oral, written)
3.4.2. Preparation of samples and reagents (practical)
3.4.3. Distribution and application of analysis on unknown samples (practical)
3.4.4. Courtroom exercise

4. Cocaine

4.1. Objectives

4.1.1. Become familiar with the coca plant and illicit materials containing cocaine

4.1.1.1. Learn the description of and be able to recognize the coca plant and illicit materials containing cocaine (botany, physical appearance, morphological and chemical characteristics)

4.1.1.2. Learn the production of illicit materials including cocaine (isolation of cocaine from coca leaf, production of coca paste, cocaine base, “crack”) and manufacture of cocaine

4.1.1.3. Chemical constituents of forensic significance of coca plant and illicit materials containing cocaine, including by-products, adulterants and diluents, comparative analysis and establishing links between cocaine samples

4.1.1.4. Structures, physical data and pharmacology of constituents of illicit materials containing cocaine

4.1.1.5. Legal aspects concerning coca plant and illicit materials containing cocaine in state and federal legislation

4.1.2. Become familiar with the protocol for the analysis of illicit materials containing cocaine (including sampling, physical identification, extraction, presumptive (color) tests, TLC, GC/MS, GC/FID, LCMS, FTIR, analytical challenges, special pitfalls)

4.1.3. Become familiar with additional analytical techniques for the analysis of cocaine

4.1.4. Perform identification of cocaine in illicit materials

4.1.5. Perform quantification of (constituents of illicit materials containing cocaine)

4.2. Modes of Instruction

4.2.1. Self-directed study through recommended reading
4.2.2. Study questions
4.2.3. (Clarification of questions)
4.2.4. Preparation of samples and of different reagents necessary for the analysis including review of safety precautions
4.2.5. Demonstrations of samples and of analysis by trainer, with explanations
4.2.6. Interpretation of results and discussion including limitations
4.2.7. Practical exercises (Application of qualitative/quantitative analysis on known samples of ATS by trainee & Application of qualitative/quantitative analysis on unknown samples of ATS by trainee)
4.2.8. Discussion

4.3. References

4.3.1. “Terminology and Information on Drugs”, UNODC, E.03.XI.14 ISBN 92-1-148163-5, September 2003 (LINK)

4.3.2. “Recommended Methods for the Identification and Analysis of Cocaine in Seized Materials”, UNODC, ST/NAR/7Rev1, March 2012 (updated oct. 2012) (LINK)

4.3.3. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html

4.3.4. “Methods for Impurity Profiling of Heroin and Cocaine”, UNODC, ST/NAR/35, October 2005 (LINK)

4.3.5. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

4.3.6. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

4.3.7. "Analysis of Drugs Manual", United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

4.3.8. "The Analysis of Controlled Substances", Michael.D. Cole, John Wiley & Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

4.3.9. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.

4.3.10. "Clandestine Laboratory Guide for Agents and Chemists", U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology

4.3.11. "Clandestine Manufacture of Substances under International Control", UNODC, ST/NAR/10/Rev.2, August 1998 (LINK)

4.3.12. "Multilingual Dictionary of Narcotic Drugs and Psychotropic Substances Under

4.3.13. International Control (MLD)", UNODC, ST/NAR/1/rev.2, December 2006 (LINK)

4.3.14. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

4.3.15. "The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals", O'Neil, Maryadele J. et al, 14th Edition, 2006, 2009 by Merck & Co., Inc., Whitehouse Station, New Jersey, USA (LINK)

4.3.16. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

4.3.17. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

4.3.18. "The Pharmacological Basis of Therapeutics", Goodman & Gilman's, New York, 11/E, 2006, McGraw-Hill

4.4. Assessment

4.4.1. Study questions (oral, written)
4.4.2. Preparation of samples and reagents (practical)
4.4.3. Distribution and application of analysis on unknown samples (practical)
4.4.4. Courtroom exercise (mini-mock trial)

5. Opium Alkaloids and Opium Derivatives

5.1. Objectives

5.1.1. Become familiar with the opium, opium alkaloids, and opium derivatives (heroin), including semi-synthetic opioids (e.g. oxycodone, hydrocodone, etc)

5.1.1.1. Description of and the recognition of illicit opium products (botany, physical appearance, morphological and chemical characteristics, opium preparations)

5.1.1.2. Production of illicit opium products (isolation of morphine from opium, manufacture of heroin from morphine)

5.1.1.3. Chemical constituents of forensic significance of illicit opium products and derivatives, including by-products, adulterants and diluents, comparative analysis and establishing links between samples

5.1.1.4. Structures and pharmacology of constituents of opium, opium derivatives (heroin), and semi-synthetic opioids

5.1.1.5. Legal aspects concerning opium, opium derivatives (heroin), and semi-synthetic opioids in state and federal legislation

5.1.2. Become familiar with the protocol for the analysis of illicit opium, opium products, opium derivatives (heroin) and semisynthetic opioids (including sampling, physical examination, microscopy, extraction, presumptive (color) tests, GC/MS, LC/MS, FTIR, UV-VIS, analytical challenges, special pitfalls)

5.1.3. Become familiar with additional analytical techniques for the analysis of illicit opium, opium products, opium derivatives (heroin), and semi-synthetic opioids

5.1.4. Perform identification of illicit opium, opium products, opium derivatives (heroin), and semi-synthetic opioids

5.1.5. Perform quantification of constituents of illicit opium, opium products, opium derivatives (heroin), and semi-synthetic opioids

5.2. Modes of Instruction

5.2.1. Self-directed study through recommended reading
5.2.2. Study questions
5.2.3. (Clarification of questions)
5.2.4. Preparation of samples and of different reagents necessary for the analysis including review of safety precautions
5.2.5. Demonstrations of samples and of analysis by trainer, with explanations
5.2.6. Interpretation of results and discussion including limitations
5.2.7. Practical exercises (Application of qualitative/quantitative analysis on known samples of ATS by trainee & Application of qualitative/quantitative analysis on unknown samples of ATS by trainee)

5.3. References

5.3.1. “Terminology and Information on Drugs”, UNODC, E.03.XI.14 ISBN 92-1-148163-5, September 2003 (LINK)

5.3.2. “Recommended Methods for Testing Opium, Morphine and Heroin”, UNODC, ST/NAR/29/Rev.1, June 1998 (LINK)

5.3.3. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html

5.3.4. “Methods for Impurity Profiling of Heroin and Cocaine”, UNODC, ST/NAR/35, October 2005 (LINK)

5.3.5. “Some Aspects of the Gas Chromatographic (GC) Analysis of Heroin”, UNODC, SCITEC/5, February 1989 (LINK)

5.3.6. “Clandestine Manufacture of Substances under International Control”, UNODC, ST/NAR/10/Rev.2, August 1998 (LINK)

5.3.7. Clarke, E. G. C. (2004). *Clarke’s Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

5.3.8. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

5.3.9. “Analysis of Drugs Manual”, United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

5.3.10. “The Analysis of Controlled Substances”, Michael.D. Cole, John Wiley & Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

5.3.11. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.

5.3.12. “Multilingual Dictionary of Narcotic Drugs and Psychotropic Substances Under International Control (MLD)”, UNODC, ST/NAR/1/rev.2, December 2006 (LINK)

5.3.13. “Clandestine Laboratory Guide for Agents and Chemists”, U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology

5.3.14. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

5.3.15. “The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals”, O'Neil, Maryadele J. et al, 14th Edition, 2006, 2009 by Merck & Co., Inc., Whitehouse Station, New Jersey, USA (LINK)

5.3.16. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

5.3.17. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

5.3.18. “The Pharmacological Basis of Therapeutics”, Goodman & Gilman’s, New York, 11/E, 2006, McGraw-Hill

5.4. Assessment

5.4.1. Study questions (oral, written)
5.4.2. Preparation of samples and reagents (practical)
5.4.3. Distribution and application of analysis on unknown samples (practical)
5.4.4. Courtroom exercise (mini-mock trial)

6. LSD and Hallucinogens

6.1. Objectives

6.1.1. Become familiar with the products containing LSD, Psilocybin/Psilocin (Psilocybe Mushrooms) and other substituted tryptamines, Mescaline (Peyote Cactus – Mescal Buttons), as well as other hallucinogenic phenethylamines (2-CB, STP, DOB, TMA, etc, also referred to in section "Amphetamine Type Stimulants" through

6.1.1.1. Description of and the recognition of illicit products containing LSD, Psilocybin/Psilocin (Psilocybe Mushrooms) and other substituted tryptamines, Mescaline (Peyote Cactus – Mescal Buttons), as well as other hallucinogenic phenethylamines (2-CB, STP, DOB, TMA, etc.)

6.1.1.2. Illicit production/manufacture of LSD, Psilocybin/Psilocin (Psilocybe Mushrooms) and other substituted tryptamines, Mescaline (Peyote Cactus - Mescal Buttons), as well as other hallucinogenic phenethylamines (2-CB, STP, DOB, TMA etc)

6.1.1.3. Chemical compounds, structures and pharmacology of LSD products. Chemical constituents of forensic interest in and pharmacology of Peyote Cactus, Mescal Buttons and Psilocybe Mushrooms, as well as other substituted tryptamines and other hallucinogenic phenethylamines

6.1.1.4. Legal aspects concerning LSD, Psilocybin/Psilocin (Psilocybe Mushrooms) and other substituted tryptamines, Mescaline (Peyote Cactus - Mescal Buttons), as well as other hallucinogenic phenethylamines (2-CB, STP, DOB, TMA etc) in state and federal legislation

6.1.2. Familiarity with the protocol for the analysis of LSD products (including physical identification, sampling, extraction, presumptive tests (fluorescence, color tests), GC/MS, HPLC, FT-IR, analytical challenges)

6.1.3. Familiarity with the protocol for the analysis of Psilocybin/Psilocin (Psilocybe Mushrooms) and other substituted tryptamines (including physical (macroscopic and microscopic) characteristics, identification, sampling, extraction, presumptive (color tests), GC/MS, LC/MS, FT-IR, special pitfalls)

6.1.4. Familiarity with the protocol for the analysis of Mescaline (Peyote Cactus - Mescal Buttons), as well as other hallucinogenic phenethylamines (2-CB, STP, DOB, TMA etc) (including physical -macroscopic and microscopic characteristics- identification, sampling, extraction, presumptive (color tests), GC/MS, LC/MS, FT-IR, special pitfalls)

6.1.5. Familiarity with additional analytical techniques for the analysis of LSD and hallucinogens (substituted tryptamines and hallucinogenic phenethylamines)

6.1.6. Perform identification of LSD, Mescaline, Psilocybin/Psilocin, and other substituted tryptamines and hallucinogenic phenethylamines, in illicit materials, including Peyote Cactus, Mescal Buttons and Psilocybe Mushrooms

6.1.7. Perform quantification of LSD, Mescaline, Psilocybin/Psilocin and other substituted tryptamines and hallucinogenic phenethylamines, in illicit materials, including Peyote Cactus, Mescal Buttons and Psilocybe Mushrooms

6.2. Modes of Instruction

6.2.1. Studying of suggested references/assignments
6.2.2. Clarification on questions

6.2.3. Preparation of samples and of different reagents necessary for the analysis including review of safety precautions
6.2.4. Demonstrations of samples and of analysis by trainer, with explanations
6.2.5. Interpretation of results and discussion including limitations
6.2.6. Application of qualitative/quantitative analysis on known samples of illicit materials containing LSD and hallucinogens by trainee
6.2.7. Application of qualitative/quantitative analysis on unknown samples by trainee
6.2.8. Discussion

6.3. References

6.3.1. "Terminology and Information on Drugs", UNODC, E.03.XI.14 ISBN 92-1-148163-5, September 2003 (LINK)

6.3.2. "Recommended Methods for Testing Lysergide (LSD)", UNODC, ST/NAR/17, January 1989 (LINK)

6.3.3. "Recommended Methods for Testing Peyote Cactus (Mescal Buttons)/Mescaline and Psilocybe Mushrooms/Psilocybin", UNODC, ST/NAR/19, December 1989

6.3.4. "Hallucinogens: a Forensic Drug Handbook", Laing R, Siegel JA, Academic Press, 2003

6.3.5. "The Botany and Chemistry of Hallucinogens", Schultess L and Hoffman A, Springfield, IL, USA, CC Thomas, 1991.

6.3.6. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

6.3.7. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html

6.3.8. "The Analysis of Controlled Substances", Michael.D. Cole, John Wiley & Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

6.3.9. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.

6.3.10. "Controlled Substances Training Manual", Virginia Department of Forensic Science, DFS Document 221-D200, Revision 1, February 2009

6.3.11. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

6.3.12. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

6.3.13. "Analysis of Drugs Manual", United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

6.3.14. "Clandestine Manufacture of Substances under International Control", UNODC, ST/NAR/10/Rev.2, August 1998

6.3.15. "TIHKAL (Tryptamines I Have Known And Loved) The Chemistry continues", Alexander and Ann Shulgin, Transform Press, 1997 (link updated oct. 2012)

6.3.16. "Multilingual Dictionary of Narcotic Drugs and Psychotropic Substances Under

6.3.17. International Control (MLD)", UNODC, ST/NAR/1/rev.2, December 2006

6.3.18. “The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals”, O'Neil, Maryadele J. et al, 14th Edition, 2006, 2009 by Merck & Co., Inc., Whitehouse Station, New Jersey, USA

6.3.19. “The Pharmacological Basis of Therapeutics”, Goodman & Gilman’s, New York, 11/E, 2006, McGraw-Hill

6.3.20. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

6.3.21. “Clandestine Laboratory Guide for Agents and Chemists”, U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology

6.4. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

6.5. Assessment

6.5.1. Study questions (oral, written)
6.5.2. Preparation of samples and reagents (practical)
6.5.3. Distribution and application of analysis on unknown samples (practical)
6.5.4. Courtroom exercise (mini-mock trial)

7. Steroids

7.1. Objectives

7.1.1. Familiarity with the illicit materials and pharmaceutical preparations including:

7.1.1.1. Anabolic agents (e.g. steroids) such as stanolone, methanedienone, nandrolone deconoate, testosterone, testosterone propionate
7.1.1.2. Familiarity with steroids classification (androgens, estrogens, adrenals) and steroid preparations
7.1.1.3. Descriptions of steroid formulations (oils, tablets, suspensions)
7.1.1.4. Chemical constituents of forensic significance
7.1.1.5. Structures and pharmacology of steroid preparations
7.1.1.6. Legal aspects concerning steroids
7.1.1.7. Familiarity with the protocol for analysis of steroids, for example, the advantages and limitations of the utilization of extractions, Kovat's indices, TLC, IR and GC/MS.

7.1.2. Description/recognition of illicit materials and pharmaceutical preparations (physical appearance, morphological characteristics, markings)

7.1.3. Chemical constituents of forensic significance of illicit materials and pharmaceutical preparations containing substances prohibited in doping control

7.1.4. Structures and pharmacology of illicit materials and pharmaceutical preparations containing substances prohibited in doping control

7.1.5. Legal aspects concerning illicit materials and pharmaceutical preparations containing substances prohibited in doping control in state and federal legislation

7.1.6. Become familiar with the protocol for the analysis of illicit materials and pharmaceutical preparations containing substances prohibited in doping control (including sampling, physical identification, presumptive tests, GC/NPD, GC/MS, LC/MS, analytical challenges, special pitfalls)

7.1.7. Perform identification of illicit materials and pharmaceutical preparations containing steroids

7.1.8. Perform quantification of illicit materials and pharmaceutical preparations containing steroids

7.2. Modes of Instruction

7.2.1. Studying of suggested references/assignments
7.2.2. Clarification on questions
7.2.3. Preparation of samples and of different reagents necessary for the analysis including review of safety precautions
7.2.4. Demonstrations of samples and of analysis by trainer, with explanations
7.2.5. Interpretation of results and discussion including limitations
7.2.6. Application of qualitative/quantitative analysis on known samples of illicit materials containing substances prohibited in doping control by trainee
7.2.7. Application of qualitative/quantitative analysis on unknown samples by trainee
7.2.8. Discussion

7.3. References

7.3.1. Schanzer W. Metabolism of anabolic androgenic steroids. Clin Chem. 1996:42:1001-1020.

7.3.2. Thevis M, Thomas A, Kohler M, et al. Emerging drugs: mechanism of action, mass spectrometry and doping control analysis. J. Mass Spectrom. 2009;44:442-460.

7.3.3. Thevis M, Thomas A, Kohler M et al. Mass spectrometry-based characterization of new drugs and methods of performance manipulation in doping control analysis. Eur J Mass Spectrom (Chichester, Eng). 2010;16(3):301-12.

7.3.4. "Multilingual Dictionary of Narcotic Drugs and Psychotropic Substances Under International Control (MLD)", UNODC, ST/NAR/1/rev.2, December 2006

7.3.5. "The Pharmacological Basis of Therapeutics", Goodman & Gilman's, New York, 11/E, 2006, McGraw-Hill

7.3.6. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

7.3.7. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

7.3.8. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

7.3.9. Moffat, A.C. editor. Clarke's Isolation and Identification of Drugs. London: The Pharmaceutical Press, 1986.

7.3.10. Clarke, E.G.C. *Isolation and Identification of Drugs, Volumes 1 and 2.* London: The Pharmaceutical Press, 1978.

7.3.11. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

7.3.12. "Analysis of Drugs Manual", United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

7.3.13. *Physician's Desk Reference.* Montvale, N.J.: Medical Economics, various editions.

7.3.14. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

7.3.15. Identadex, *Micromedex*, website subscription.

7.3.16. DEA Logo Index, printed versions.

7.3.17. Drugs.com

7.3.18. Budavari, Susan, editor. The Merck Index, Eleventh Edition. Rahway, N.J..: Merck & Co., Inc., 1989.

7.3.19. "The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals", O'Neil, Maryadele J. et al, 14th Edition, 2006, 2009 by Merck & Co., Inc., Whitehouse Station, New Jersey, USA

7.3.20. "Martindale: The Complete Drug Reference", Sweetman M., Pharmaceutical Press, 36th Edition, 2006

7.3.21. "Instrumental Data for Drug Analysis", Terry Mills III and J.Conrad Robertson, second edition, 1993

7.3.22. "Uppers, Downers, All-Arounders, Inaa, D.S., Cohen W.E., 5th edition, CNS Publications Inc.: Oregon, 2004, Anabolic Steroids, p. 279-281

7.3.23. "Analytical Profiles of Anabolic Steroids", Aubum, Alabama 36831, PO Box 1527, CND Analytical 1989

7.4. Assessment

7.4.1. Study questions (oral, written)
7.4.2. Preparation of samples and reagents (practical)
7.4.3. Distribution and application of analysis on unknown samples (practical)
7.4.4. Courtroom exercise (mini-mock trial)

8. Other Drugs and Pharmaceuticals

8.1. Objectives

8.1.1. Become familiar with the illicit materials and pharmaceutical preparations containing controlled substances, as well as "designer" or new drugs, namely:

8.1.1.1. benzodiazepine derivatives
8.1.1.2. barbiturate derivatives
8.1.1.3. synthetic opioids (pethidine, fentanyl and analogues, methadone, d-propoxyphene etc)
8.1.1.4. GHB / GBL
8.1.1.5. PCP and analogues, ketamine

8.1.2. Become familiar with the description/recognition of illicit materials and pharmaceutical preparations (physical appearance, morphological characteristics, markings)

8.1.3. Become familiar with the production/manufacture of illicit materials containing controlled substances

8.1.4. Become familiar with the chemical constituents of forensic significance of illicit materials and pharmaceutical preparations containing controlled substances

8.1.5. Learn the structures and pharmacology of illicit materials and pharmaceutical preparations containing controlled substances

8.1.6. Become familiar with applicable Texas Controlled Substances Act penalty groups

8.1.7. Learn legal aspects concerning illicit materials and pharmaceutical preparations containing controlled substances in state and federal legislation

8.1.8. Become familiar with the analytical procedures for pharmaceutical preparations

8.1.9. Become familiar with the protocol for the analysis of illicit materials and pharmaceutical preparations containing controlled substances (including sampling, physical identification, presumptive tests, TLC, GC, GC/MS, HPLC, LC/MS, FT-IR, analytical challenges, special pitfalls)

8.1.10. Become familiar with additional analytical techniques for the analysis of other drugs and pharmaceuticals

8.1.11. Become familiar with reporting guidelines

8.1.12. Perform identification of illicit materials and pharmaceutical preparations containing controlled substances

8.1.13. Perform quantification of illicit materials and pharmaceutical preparations containing controlled substances

8.2. Modes of Instruction

8.2.1. Self-directed study through recommended reading
8.2.2. (Clarification of questions)
8.2.3. Identification of and demonstrations of proper use of identification sources
8.2.4. Preparation of samples and of different reagents necessary for the analysis including review of safety precautions

8.2.5. Demonstrations of samples and of analysis by trainer, with explanations
8.2.6. Interpretation of results and discussion including limitations
8.2.7. Application of qualitative/quantitative analysis on known samples of illicit materials containing pharmaceuticals and other drugs by trainee
8.2.8. Application of qualitative/quantitative analysis on unknown samples by trainee
8.2.9. Discussion

8.3. References

8.3.1. "Terminology and Information on Drugs", UNODC, E.03.XI.14 ISBN 92-1-148163-5, September 2003

8.3.2. "Recommended Methods for Testing Barbiturate Derivatives under International Control", UNODC, ST/NAR/18, December 1989

8.3.3. "Recommended Methods for Testing Benzodiazepine Derivatives under International Control", UNODC, ST/NAR/16, December 1988

8.3.4. "The Identification and Analysis of Benzodiazepines under International Control: I.Colour Tests and Chromatographic Methods", UNODC, SCITEC/1, December 1987

8.3.5. "Recommended Methods for Testing Methaqualone/Mecloqualone", ST/NAR/15, December 1988

8.3.6. "Studies on Colour Tests for Field Detection of Narcotic Drugs and Psychotropic Substances under International Control (No. II). Screening Colour Test and Specific Colour Test for the Detection of Non-barbiturate Sedatives and Hypnotics: Methaqualone and Mecloqualone", SCITEC/13, December 1996

8.3.7. "The Analysis of Controlled Substances", Michael.D. Cole, John Wiley & Sons Ltd., The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

8.3.8. Gough, T. (Ed.) (1991). *The Analysis of Drugs of Abuse*. New York, NY: John Wiley & Sons, Ltd.

8.3.9. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html

8.3.10. "Clandestine Manufacture of Substances under International Control", UNODC, ST/NAR/10/Rev.2, August 1998

8.3.11. "Multilingual Dictionary of Narcotic Drugs and Psychotropic Substances Under

8.3.12. International Control (MLD)", UNODC, ST/NAR/1/rev.2, December 2006

8.3.13. "The Pharmacological Basis of Therapeutics", Goodman & Gilman's, New York, 11/E, 2006, McGraw-Hill

8.3.14. Hardman, J., & Limbird, L. (Eds.) (1996). *The Pharmacological Basis of Therapeutics* (9th ed.). New York, NY: McGraw-Hill Companies.

8.3.15. Marnell, Tim (Ed.) (2007) *Drug Identification Bible*. Hard copy and CD versions. Grand Junction: Amera-Chem, Inc.

8.3.16. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

8.3.17. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

8.3.18. "Analysis of Drugs Manual", United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

8.3.19. “Clandestine Laboratory Guide for Agents and Chemists”, U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology

8.3.20. “Controlled Substances Training Manual”, Virginia Department of Forensic Science, DFS Document 221-D200, Revision 1, February 2009

8.3.21. “Controlled Substances Procedures Manual”, Virginia Department of Forensic Science, DFS Document 221-D100, Revision 8, August 2012

8.3.22. “Physician’s Desk Reference”, Montvale, N.J.: Medical Economics

8.3.23. “The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals”, O'Neil, Maryadele J. et al, 14th Edition, 2006, 2009 by Merck & Co., Inc., Whitehouse Station, New Jersey, USA

8.3.24. “Martindale: The Complete Drug Reference”, Sweetman M., London Pharmaceutical Press, 36th Edition, 2006

8.3.25. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

8.3.26. Ciolino, L. A., et al., “The Chemical Interconversion of GHB and GBL” Forensic Issues and Implications” Journal of Forensic Sciences, 2001, Vol. 46 No.6, pp. 1315-1323.

8.3.27. Bommrito, C. “Analytical Profile of Gamma-Hydroxybutyric Acid (GHB)” Journal of the Clandestine laboratory Investigating Chemists Associations, Vol.3, No.3, 1993.

8.3.28. Chappell, J. S. “The Non-equilibrium Aqueous Solution Chemistry of Gamma-Hydroxybutyric Acid: Journal of the Clandestine laboratory Investigating Chemists Associations, Vol.12, No.4, 2002.

8.3.29. Discussion

8.4. Assessment

8.4.1. Study questions (oral, written)
8.4.2. Preparation of samples and reagents (practical)
8.4.3. Use various sources for identification of pharmaceutical tablets (practical)
8.4.4. Distribution and application of analysis on unknown samples (practical)
8.4.5. Courtroom exercise (mini-mock trial)

Laboratory Practices

9. Evidence handling and security

9.1. Objectives

9.1.1. Learn the procedures applied in the collection, receipt, protection, handling, storage, analysis of samples/evidence, as well as documentation, evaluation, report writing and communication of results

9.1.2. Learn to choose the best case approach, preparation of samples and handling of evidence, implementation of analytical schemes and methodology, and reporting of results, for each individual case

9.1.3. Interpret and handle analytical data and related information so as to create and use respective databases

9.2. Modes of Instruction

9.2.1. Self-directed study through recommended reading
9.2.2. (Clarification of questions)
9.2.3. Demonstration and instruction on proper use of the RMS computer system and LIMS
9.2.4. Study questions
9.2.5. Practical exercises
9.2.6. Discussion
9.2.7. Studying of, clarification of questions and discussion on documentation of the administrative, organizational and scientific/analytical aspects of laboratory work (e.g. Quality Manual, Best Practices manual, SOP's etc)
9.2.8. Demonstration/guidance by trainer with explanations on standards or protocols implemented with respect to :

9.2.8.1. case approach
9.2.8.2. general analytical schemes for unknown samples / powders / tablets / capsules / herbal material
9.2.8.3. weighing practices
9.2.8.4. sampling practices
9.2.8.5. choice of analytical methodology
9.2.8.6. validation/verification of methods
9.2.8.7. application of techniques per substance(s)
9.2.8.8. development of SOPs
9.2.8.9. equipment performance and control, preventive maintenance
9.2.8.10. quality control
9.2.8.11. interpretation and reporting of the results
9.2.8.12. documents and case records
9.2.8.13. handling/storage of samples/evidentiary material
9.2.8.14. handling/storage of information, access to databases
9.2.8.15. chain of custody

9.2.8.16. communication with clients (including communication language, establishing needs, dealing with undue pressure etc)
9.2.8.17. health and safety
9.2.8.18. responsibilities, duties and skills of the personnel
9.2.8.19. education and training of personnel

9.2.9. Practice in implementation of the (best) practices, (quality assurance) principles and criteria of the laboratory, at technical and management level

9.2.10. Discussion

9.3. References

9.3.1. Procedures Manual(s) of the laboratory

9.3.2. “ENFSI Code of Conduct”, ENFSI/QCC, Ref.Code BRD-GEN-003, Issue No 002, 16 June 2005 (link updated oct 2012)

9.3.3. "Guidance for the Implementation of a Quality Management System in Drug Testing Laboratories", United Nations Office on Drugs and Crime, ST/NAR/37, March 2009

9.3.4. “'Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories”, UNODC, 2011 (link updated oct. 2012)

9.3.5. “Validation of analytical methodology and calibration of equipment used for testing of illicit drugs in seized materials and biological specimen”, United Nations Office on Drugs and Crime, 2009

9.3.6. “Glossary of Terms for Quality Assurance and Good Laboratory Practices”, United Nations Office on Drugs and Crime, ST/NAR/26/Rev.1, December 2009

9.3.7. “Recommended Guidelines for Quality Assurance and Good Laboratory Practice” United Nations Office on Drugs and Crime, STR/NAR/25, 1995

9.3.8. “Guidelines for Forensic Science Laboratories”, International Laboratory Accreditation Cooperation, ILAC-G19:2002

9.3.9. “Guidelines for the import and export of drug and precursor reference standards”, The International Narcotics Control Board (INCB), 2007

9.3.10. “Recommendations", Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) (link updated oct. 2012)

9.3.11. Forensic Science Institutes (ENFSI/002)

9.3.12. “Guidance on the production of best practice manuals within ENFSI”, ENFSI QCC-BPM-008, 2008

9.3.13. Furr AK, “Handbook of Laboratory Safety”, CRC Press, 5th Ed., 2000

9.3.14. Armour M A, “Hazardous Laboratory Chemicals Disposal Guide”, 3rd edition, CRC, 2003

9.3.15. “Prudent Practices in the Laboratory”, National Research Council (U.S.), Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories, National Academies Press, 1995

9.3.16. “Handbook of Laboratory Health and Safety”, Sticoff RS, and Walters DB, 2nd edition, John Wiley & Sons, 1995

9.3.17. “ASTM E 1459-92: Standard Guide for Physical Evidence Labeling and Related Documentation”, American Society for Testing and Materials, West Conshohocken, Pennsylvania

9.3.18. “ASTM E 1492-05: Standard Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory”, American Society for Testing and Materials, West Conshohocken, Pennsylvania

9.3.19. “Analytical Instrumentation - Performance Characteristics & Quality”, Currell G, John Wiley & Sons, 2000

9.3.20. “Applications of Reference Materials in Analytical Chemistry”, Barwick V et al, The Royal Society of Chemistry, LGC, Teddington, 2001

9.3.21. “Sample Pretreatment and Separation”, Analytical Chemistry by Open Learning, R. G. Anderson, John Wiley & Sons, Chichester, West Sussex, UK, 1987

9.3.22. “Samples and Standards”, Analytical Chemistry by Open Learning, B.W.Woodget, D.Cooper, John Wiley & Sons, Chichester, West Sussex, UK, 1987

9.3.23. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

9.4. Assessment

9.4.1. Study questions (oral, written)

9.4.2. Practical exercise on the implementation of procedures in compliance with the Quality Management System of the laboratory, at all stages of processes

10. Laboratory Safety

10.1. Objectives

10.1.1. Knowledge about safe working practices in the laboratory and at crime scene
10.1.2. Ability to prevent service-related accidents, injuries, illnesses of personnel and damage to equipment, at laboratory and at crime scene
10.1.3. Ability to assess and manage risk and emergency situations
10.1.4. Active participation in implementation of safe working systems including evaluations and review. Consequent development of safety consciousness
10.1.5. Ability in safety documenting including maintenance of a safety manual, including designated staff, emergency procedures, contact information, training, accommodation, personal protective equipment, general hygiene/safety and biological/radioactivity hazards, risk assessment and risk management

10.2. Modes of Instruction

10.2.1. Study questions over:

10.2.1.1. Properties of hazardous materials, including incompatibilities
10.2.1.2. Use/meaning of hazard identification symbols, Risk and Safety phrases
10.2.1.3. Interpretation of Material Safety Data Sheets
10.2.1.4. safety guidelines (in the laboratory and at crime scene), precautions and rules/procedures with respect to handling compressed gases, flammable, toxic and corrosive substances, bio-hazardous materials, glassware, high-intensity light sources (including UV lamps and lasers), etc, including safe transportation, storage and disposal
10.2.1.5. Hazards involved with analytical instruments and apparatuses operation (high temperatures, radiation etc)
10.2.1.6. Dealing with risk and emergency situations
10.2.1.7. Scientific and technical literature on the issue

10.2.2. Demonstrations on:

10.2.2.1. Use of (personal) protective equipment and physical barriers that are used both to protect the analyst from the evidence and reagents, and the evidence from the analyst, including capabilities and limitations
10.2.2.2. Use of fire-fighting equipment
10.2.2.3. First aid and emergency procedures

10.2.3. Practical exercise on:

10.2.3.1. Implementation of risk assessment of hazardous chemicals/material and situations

10.3. References

10.3.1. “Recommended Guidelines for Quality Assurance and Good Laboratory Practices” United Nations Office on Drugs and Crime, ST/NAR/25, 1995

10.3.2. “Guidance for the implementation of a quality management system in drug testing laboratories – a commitment to quality and continuous improvement, United Nations Office on Drugs and Crime, ST/NAR/37, 2009

10.3.3. “Guidelines for the Safe Handling and Disposal of Chemicals Used in the Illicit Manufacture of Drugs”, ST/NAR/36 rev.1, UNODC, 2011.

10.3.4. “Data Sheets on Substances Frequently Used in the Illicit Manufacture of Narcotic Drugs or Psychotropic Substances”, SCITEC/9/REV.1, April 1993

10.3.5. “Recommendations", Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) (link updated Oct. 2012)

10.3.6. “NIOSH Pocket Guide to Chemical Hazards”, Department of health and human services, National Institute for Occupational Safety and Health, 2005 (link updated oct. 2012)

10.3.7. “Guidelines for Laboratory Design: Health and Safety Considerations”, Di Berardinis JL, Baum JS and First MW, Wiley, 2nd edition, 1992

10.3.8. “DRCHIS: Drugs geRelateerd CHemicalien Informatie Systeem”, A. Elissen, M.L. Hordijk, Dutch National Criminal Intelligence Division, May 1999

10.3.9. “Chemicals used in the Clandestine Production of Drugs”, US Department of Justice, Drug Enforcement Administration, Office of Diversion Control, Drug and Chemical Evaluation Section

10.3.10. Relevant material safety data sheets

10.3.11. “Handbook of Laboratory Safety”, Furr AK, CRC Press, 5th Ed., 2000

10.3.12. “Hazardous Laboratory Chemicals Disposal Guide”, Armour M A, 3rd edition, CRC, 2003

10.3.13. “Prudent Practices in the Laboratory”, National Research Council (U.S.), Committee on “Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories, National Academies Press, 1995

10.3.14. “Handbook of Laboratory Health and Safety”, Sticoff RS, and Walters DB, 2nd edition, John Wiley & Sons, 1995

10.4. Assessment

10.4.1. Study questions (oral, written)
10.4.2. Practical exercise

11. Balances

11.1. Objectives

11.1.1. Familiarity with the operation of balances
11.1.2. Familiarity with balance calibration and quality assurance practices
11.1.3. Ability to record and report weights

11.2. Modes of Instruction

11.2.1. Self-directed study through recommended reading
11.2.2. (Clarification of questions)
11.2.3. Presentations and demonstrations of proper use of balances
11.2.4. Study questions
11.2.5. Practical exercise
11.2.6. Discussion

11.3. References

11.3.1. Balance manufacturer's operating manuals
11.3.2. Mettler Toledo Good Weighing Practices Guide
11.3.3. ADD MORE

11.4. Assessment

11.4.1. Written examination
11.4.2. Weight recording exercise of known samples (practical)
11.4.3. Oral examination or courtroom exercise (optional)

12. Sampling

12.1. Objectives

12.1.1. Familiarity with the concepts of sampling
12.1.2. Familiarity with sampling procedures for sampling

12.2. Modes of Instruction

12.2.1. Self-directed study through recommended reading
12.2.2. (Clarification of questions)
12.2.3. Presentation of case studies and demonstrations
12.2.4. Practical exercises
12.2.5. Discussion

12.3. References

12.3.1. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

12.3.2. "Sampling for Analytical Purposes", Gy P, John Wiley & Sons Ltd., 1998

12.3.3. Coulson, Sally A., Ph.D. et al., "How Many Samples from a Drug Seizure Need to Be Analyzed?" Journal of Forensic Science, Volume 46, No. 6 (November 2001), pp 1456-1461.

12.3.4. Colon, aria, B.S. Rodriguez, Gloria, B.S., and Diaz, Ramon Orlando, M.S. "Representative Sampling of "Street' Drug Exhibits", Journal of Forensic Science, Volume, 38, No 3 (May 1993), pp. 641-648.

12.3.5. Tzidony, Dov, and Ravreby, Mark. "A Statistical Approach to Drug Sampling: A Case Study", Journal of Forensic Sciences, Volume 37, No.6 (November 1992), pp 1541-1549.

12.3.6. Frank, Richard S., B.S., Hinkley, Sidney W., Ph.D., and Hoffman, Carolyn G., M.A. "Representative Sampling of Drug Seizures on Multiple Containers", Journal of Forensic Sciences, Volume 36, No 2 (March 1191), pp. 350-357.

12.4. Assessment

12.4.1. Selection of samples for analysis on unknown samples (practical)
12.4.2. Oral examination and/or courtroom exercise (optional)
12.4.3. Written examination

13. Measurement Uncertainty

13.1. Objectives

13.1.1. Become familiar with the concepts of measurement of uncertainty for weights and quantitations
13.1.2. Become familiar with General metrology to include: terminology, symbols, formulae, publications
13.1.3. Learn about the concepts of random and systematic error, accuracy, precision (repeatability, reproducibility, and their conditions), statistical control, standard and expanded uncertainty, correlation and propagation of error
13.1.4. Learn the reporting conventions including use of significant figures, truncation and rounding
13.1.5. Learn basic statistics (descriptive and inferential) to include: measures of central tendency (e.g., median), measures of variation, statistical modeling, sampling, probability, confidence interval, and significance level

13.2. Modes of Instruction

13.2.1. Self-directed study through recommended reading
13.2.2. (Clarification of questions)
13.2.3. Presentation of case studies and demonstrations
13.2.4. Practical exercise
13.2.5. Discussion

13.3. References (from SWGDRUG)

13.3.1. Eurachem/CITAC Guide: The Expression of Uncertainty in Qualitative Testing, Committee Draft September 2003.

13.3.2. GUM, Evaluation of measurement data — Guide to the expression of uncertainty in measurement Published by the Joint Committee for Guides in Metrology (JCGM), JCGM 100:2008.

13.3.3. Guidelines for Evaluation and Expressing the Uncertainty of NIST Measurement Results, National Institute of Standards and Technology, NIST Technical Note 1297, 1994 Edition.

13.3.4. General requirements for the competence of testing and calibration laboratories International Organization for Standardization, ISO/IEC 17025: 2005.

13.3.5. Guide for the use of the International System of Units (SI), Taylor, B.N., National Institute of Standards and Technology, April 1995.

13.3.6. Standard Practice of Using Significant Digits in Test Data to Determine Conformance with Specifications, ASTM E29, West Conshohosken, PA.

13.3.7. Quantifying Uncertainty in Analytical Measurements, Eurachem, 2000, 2nd ED.

13.3.8. Experimental Statistics, M. Natrella, National Bureau of Standards (NBS), USA 1966.

13.3.9. ISO 3534-1 Statistics — Vocabulary and symbols Part 1: General statistical terms and terms used in probability, ISO 3534-2 Statistics — Vocabulary and symbols Part 2: Applied statistics International Organization for Standardization, Switzerland, 2006.

13.3.10. ISO Guide 99:2007 The International Vocabulary of Basic and General Terms in Metrology, International Organization for Standardization, Switzerland, 2007.

13.3.11. ISO 5725-1 Accuracy (Trueness and Precision) of Measurement Methods and Results Part 1: General Principles and Definitions International Organization for Standardization, Switzerland,1994.

13.3.12. The Uncertainty of Measurements. Physical and Chemical Metrology Impact and Analysis. Kimothi, S.K., Milwaukee: American Society for Quality, 2002.

13.3.13. Fundamentals of Analytical Chemistry, 8th Edition, Skoog, D.A., et al. Brooks Cole, 2003.

13.3.14. Measurement Uncertainty Arising from Sampling: A Guide to Methods and Approaches. Eurachem/CITAC Guide, 1st edition, 2007.

13.3.15. ASTM E2655 Standard Guide for Reporting Uncertainty of Test Results and Use of the Term Measurement Uncertainty in ASTM Test Methods.

13.4. Assessment

13.4.1. (Practical)
13.4.2. Oral examination and/or courtroom exercise (optional)
13.4.3. Written examination

14. Quality Assurance

14.1. Objectives

14.1.1. Awareness of the significance of the quality of analyses and forensic laboratory results for the law enforcement, justice system, crime prevention and health, as well as for the international harmonization and worldwide exchange and coordination of drug information and data
14.1.2. Knowledge of the Quality policy of the laboratory
14.1.3. Knowledge of the requirements of ISO 17025, as interpreted for forensic laboratories
14.1.4. Knowledge of the structure of the Quality Management System of the laboratory or of the Best Practices applied
14.1.5. Ability to comply with the technical requirements established in the Quality Management System and/or Quality Standards of the laboratory
14.1.6. Ability to comply with the management requirements established in the Quality Management System and/or Quality Standards of the laboratory

14.2. Modes of Instruction

14.2.1. Self-directed study through recommended reading
14.2.2. (Clarification of questions)
14.2.3. Presentation by trainer and discussion on:

14.2.3.1. national legislative, jurisdictional and regulatory requirements
14.2.3.2. institutional and organizational requirements of the laboratory
14.2.3.3. client requirements
14.2.3.4. external and/or international instructions, recommendations and guidelines
14.2.3.5. principles of ethical conduct

14.2.4. Studying of:

14.2.4.1. Standard ISO/IEC 17025
14.2.4.2. Quality Manual, and/or other relevant documentation of the administrative, organizational and scientific aspects of laboratory work (e.g. Best Practices manual, SOP's etc)

14.2.5. Demonstration by trainer with explanations on the laboratory quality management system and the quality standards/protocols implemented with respect to:

14.2.5.1. organization of the laboratory
14.2.5.2. laboratory environment and accommodation
14.2.5.3. responsibilities, duties and skills of the personnel
14.2.5.4. equipment choice and performance - calibration
14.2.5.5. key stages of the drug testing process :

14.2.5.5.1. - case assessment
14.2.5.5.2. - sampling
14.2.5.5.3. - handling of samples and evidentiary material
14.2.5.5.4. - development of methods
14.2.5.5.5. - development of procedures
14.2.5.5.6. - validation/verification of methods
14.2.5.5.7. - quality control (internal-external)
14.2.5.5.8. - interpretation and reporting of the results

14.2.5.6. chain of custody
14.2.5.7. documents and case records
14.2.5.8. handling of services and supplies
14.2.5.9. dealing with clients, requests and complaints
14.2.5.10. audits, corrective and preventive actions
14.2.5.11. health and safety
14.2.5.12. drug reference materials
14.2.5.13. education and training of personnel
14.2.5.14. proficiency testing

14.2.6. Practical exercises in:

14.2.6.1. implementation of the quality assurance principles and criteria of the laboratory, at technical and management level
14.2.6.2. use of quality assurance system as a safeguard to legal scrutiny

14.2.7. Discussion

14.3. References

14.3.1. "Guidance for the Implementation of a Quality Management System in Drug Testing Laboratories", United Nations Office on Drugs and Crime, ST/NAR/37, March 2009

14.3.2. "'Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", UNODC, 2011 (link updated oct. 2012)

14.3.3. "Validation of analytical methodology and calibration of equipment used for testing of illicit drugs in seized materials and biological specimen", United Nations Office on Drugs and Crime, 2009

14.3.4. "Glossary of Terms for Quality Assurance and Good Laboratory Practices", United Nations Office on Drugs and Crime, ST/NAR/26/Rev.1, December 2009

14.3.5. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

14.3.6. "Recommended Guidelines for Quality Assurance and Good Laboratory Practice" United Nations Office on Drugs and Crime, STR/NAR/25, 1995

14.3.7. ISO/IEC 17025:2005 General Requirements for Competence of Testing and Calibration Laboratories, International Organization for Standardization/International Electrotechnical Commission

14.3.8. "Guidelines for Forensic Science Laboratories", International Laboratory Accreditation Cooperation, ILAC-G19:2002

14.3.9. "Recommendations", Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) (link updated oct. 2012)

14.3.10. "Guidance on the production of best practice manuals within ENFSI", ENFSI QCC-BPM-008, 2008 (link updated oct. 2012)

14.3.11. Quality Manual of the laboratory

14.4. Assessment

14.4.1. Study Questions*
14.4.2. Practical exercise on the implementation of procedures in compliance with the Quality Management System of the laboratory, at all stages of processes*
14.4.3. Courtroom exercise

Analytical Techniques

This section covers all basic methods available for drug analysis. The trainee must become thoroughly familiar with these techniques. This will include the theory behind the operation of instruments used, basic routine maintenance, and ultimately competence in each area. This knowledge will be used during the formal mock trial.

15. Stereomicroscopes

15.1. Objectives

15.1.1. ADD

15.2. Modes of Instruction

15.2.1. Self-directed study through recommended reading
15.2.2. (Clarification of questions)
15.2.3. Presentation of case studies and demonstrations
15.2.4. Practical exercises
15.2.5. Discussion

15.3. References

15.3.1. Microscope manufacturer's operating manual
15.3.2. Saferstein, Richard, Ph.D. *Criminalistics: An Introduction to Forensic Science, Eighth Edition,* Upper Saddle River, NJ: Prentice hall, 2004, pp 175-176.
15.3.3. Saferstein, Richard, Ph.D., Editor. Forensic Science Handbook. Englewood Cliffs: Prentice Hall, 1982, pp. 416-434.

15.4. Assessment

15.4.1. Selection of samples for analysis on unknown samples (practical)
15.4.2. Written examination
15.4.3. Oral examination for courtroom exercise (optional)

16. Color Tests

16.1. Objectives

16.1.1. Knowledge of the theory and principles of the color, crystal and anion tests
16.1.2. Become familiar with preparation, storage, and proper handling procedures of the reagents
16.1.3. Become aware of the mechanisms for color test reactions
16.1.4. Learn the advantages, disadvantages, and limitations of color tests
16.1.5. Knowledge of the possibilities and limitations of the technique
16.1.6. Knowledge of quality assurance and method validation requirements
16.1.7. Ability to execute color tests on drugs most commonly encountered in the illicit traffic
16.1.8. Ability to interpret the results obtained and become proficient in the use of chemical color tests

16.2. Modes of Instruction

16.2.1. Self-directed study through recommended reading
16.2.2. (Clarification of questions)
16.2.3. Preparation of different reagents including review of safety precautions
16.2.4. Demonstrations of color tests
16.2.5. Interpretation of results and discussion including limitations
16.2.6. Application of color tests on known samples by trainee (practical)
16.2.7. Application of color tests on unknown samples by trainee (practical)
16.2.8. Discussion

16.3. References

16.3.1. United Nations Office on Drugs and Crime. (1995). *Rapid testing methods of drugs of abuse* (UNODC, ST/NAR/13/Rev. 1). Vienna, Austria: Vienna International Centre. (http://www.unodc.org/unodc/en/scientists/rapid-testing-methods-of-drugs-of-abuse.html

16.3.2. "Chemistry and Reaction Mechanisms of Rapid Tests for Drugs of Abuse and Precursor Chemicals", UNODC, SCITEC/6, February 1989

16.3.3. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

16.3.4. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

16.3.5. "Modern Microcrystal Tests for Drugs", Fulton, C.C., (1969), "Wiley-Interscience, NY

16.3.6. "Spot Tests: A Colour Chart Reference for Forensic Chemists", Johns, S. H., Wist, A. A., and Najam, A. R. Journal of Forensic Sciences, July 1979

16.3.7. "Studies on Colour Tests for Field Detection of Narcotic Drugs and Psychotropic Substances under International Control (No. II). Screening Colour Test and Specific Colour Test for the Detection of Non-barbiturate Sedatives and Hypnotics: Methaqualone and Mecloqualone", UNODC, SCITEC/13, December 1996

16.3.8. "The Identification and Analysis of Benzodiazepines under International Control: I.Colour Tests and Chromatographic Methods", UNODC, SCITEC/1, December 1987

16.3.9. "Spot Tests in Organic Analysis", Feigl F., Feigl F. and Anger V., Butterworth Heinemann, 7th edition, 2006

16.3.10. "Rapid and sensitive technique for the differentiation of the optical isomeric forms of methamphetamine and amphetamine", Cunningham, M. D. (1973). Microgram, vol. 6, No. 6, pp. 87-95

16.3.11. "Spot Test Analysis; Clinical, Environmental, Forensic, and Geochemical Applications", Jungreis E, 2nd edition, Wiley-Interscience, New York, 1984/1997

16.3.12. "Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", United Nations Office on Drugs and Crime, 2011 (link updated oct. 2012)

16.3.13. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

16.3.14. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009

16.3.15. U.S. Pharmacopeia National Formulary, USP XX, 1980

16.4. Assessment

16.4.1. Study questions
16.4.2. Preparation of color test reagents (Practical)
16.4.3. Application of color tests on unknown samples (Practical)
16.4.4. Courtroom exercise

17. Thin Layer Chromatography (TLC)

17.1. Objectives

17.1.1. Knowledge of the principle/theory of Thin Layer Chromatography in drug analysis

- 17.1.1.1. Awareness of the factors which affect separations (stationary phase, mobile phase, sample, conditions)
- 17.1.1.2. Knowledge of the criteria for selection of solvent systems, including safety and cost
- 17.1.1.3. Familiarity with visualization techniques
- 17.1.1.4. Knowledge of various visualization spray reagents for various applications
- 17.1.1.5. Awareness of possible problems and likely causes/solutions
- 17.1.1.6. Knowledge of quality assurance and method validation requirements

17.1.2. Knowledge of the principle/theory of Thin Layer Chromatography in drug analysis

- 17.1.2.1. Familiarity with the TLC equipment and associated operational procedures (pre-treatment of plates, selection of suitable solvent systems, application of samples, running the plates, location procedures, visualization, storage of chromatograms)
- 17.1.2.2. Ability to design and use multi-development and two-dimensional TLC experiments
- 17.1.2.3. Ability to resolve issues such as spot overlapping and tailing
- 17.1.2.4. Practice in the use of high-performance TLC (HPTLC)
- 17.1.2.5. Experience with preparative techniques
- 17.1.2.6. Experience in quantitative TLC

17.1.2.7. Ability in the execution of TLC to reference/known samples as well as on drugs most commonly encountered in the illicit traffic

17.1.3. Ability to interpret the results obtained
17.1.4. Knowledge of the possibilities and limitations of the technique

17.2. Modes of Instruction

17.2.1. Studying of suggested references/assignments
17.2.2. Clarification on questions
17.2.3. Preparation of different development solvents/visualization reagents including review of safety precautions
17.2.4. Demonstrations by trainer: execution of TLC, with explanations
17.2.5. Interpretation of results and discussion
17.2.6. Application of TLC on reference/known samples by trainee
17.2.7. Application of TLC on unknown samples by trainee
17.2.8. Discussion

17.3. References

17.3.1. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

17.3.2. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

17.3.3. "Thin Layer Chromatography" - Analytical Chemistry by Open Learning R.Hamilton, S.Hamilton, John Wiley & Sons, Chichester, West Sussex, U.K., 1987 ISBN 0-471-91377-4 (paperback)

17.3.4. "Handbook of Thin-Layer Chromatography", Sherma J, Fried B and Sherma S, CRC Press; 3rd Rev&Ex, 2003

17.3.5. "Thin Layer Chromatography: Reagents and Detection Methods", Jork H, Funk W, Fischer W and Wimmer H, Volume 1b, VCH Verlagsgesellschaft mbH, BRD, 1994

17.3.6. "Thin-Layer Chromatography", Stahl, E., 1969. Springer-Verlag, 1969, NY

17.3.7. Thin-Layer Chromatography", Randerath, Kurt. "Second Edition. New York: Academic Press, 1968

17.3.8. "Thin Layer Chromatography", Bauer, Karin, et. al. Heidelberg, Germany: EM Science, 1991

17.3.9. "Thin-layer chromatographic Rf values of toxicologically relevant substances on standardized systems", Deutsche Forschungsgemeinschaft (DFG) / The International Association of Forensic Toxicologists (TIAFT), 2nd, revised and enlarged edition, 1992.

17.3.10. "Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", United Nations Office on Drugs and Crime, 2011 (link updated oct 2012)

17.3.11. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

17.3.12. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009

17.4. Assessment

17.4.1. Study questions (oral, written)
17.4.2. Preparation of reagents (practical)
17.4.3. Distribution and application of TLC on unknown samples (practical)
17.4.4. Courtroom exercise (mini-mock trial)

18. Gas Chromatography (GC)

18.1. Objectives

18.1.1. Learn the theory and operation of the gas chromatograph
18.1.2. Learn to tune the mass spectrometer and perform tune evaluations
18.1.3. Become familiar with GC/MS software and the procedures for entering data in sequence table
18.1.4. Analyze mixtures of substances and identify each component
18.1.5. Learn to search available libraries

18.2. Modes of Instruction

18.2.1. Self-directed study through recommended reading
18.2.2. (Clarification of questions)
18.2.3. Demonstrations by trainer: execution of GC and GC/MS analysis, with explanations
18.2.4. Interpretation of results and discussion
18.2.5. Application of GC and GC/MS on reference/known samples by trainee
18.2.6. Application of GC and GC/MS on unknown samples by trainee, qualitative and quantitative determination
18.2.7. Discussion

18.3. References

18.3.1. Moffat, A.C. editor. *Clarke's Isolation and Identification of Drugs*. London: The Pharmaceutical Press, 1986.
18.3.2. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.
18.3.3. *Basic Training Program for Forensic Chemists*, U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology, pp. 5-31 through 5-47.
18.3.4. Stafford, David T., Ph D, "Forensic Capillary Gas Chromatography" in Saferstein, Richard, Ph.D., editor, *Forensic Science Handbook, Volume II.* Englewood Cliffs, J.J.: Prentice Hall, 1988, pp. 38-67.
18.3.5. Agilent Technologies GC instrument manuals.
18.3.6. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.
18.3.7. "Gas Chromatography" - Analytical Chemistry by Open Learning, Ian A. Fowlis, (Paperback), John Wiley & Sons Ltd, Baffins Lane, Chichester, West Sussex P019, England, 1999
18.3.8. "A Practical Guide to the Care, Maintenance and Troubleshooting of Capillary Gas Chromatographic Systems", Rood, Dean, Wiley-VCH, New York, 1999
18.3.9. "Modern Practice of Gas Chromatography", Grob RL and Barry EF, New York , Wiley-Interscience; 3rd Ed., 1995
18.3.10. "Split and Splitless Injection for Quantitative Gas Chromatography, Concepts, Process, Practical Guidelines, Sources of Error", Grob K, Wiley-VCH, 4th Ed., 2001
18.3.11. "Gas Chromatography", Prichard E and Stuart B, Royal Society of Chemistry, 2003
18.3.12. "Derivatisation Techniques for Gas Chromatography, Chromatography Today", Poole CF, Poole SK, Elsevier, 1991
18.3.13. "Mass Spectrometry – Principles and Applications", Hoffmann, E.de & Stroobant, V., editor, England, Wiley, 2001
18.3.14. "Advances in Forensic Applications of Mass Spectrometry", Yinon J, 2004
18.3.15. "Chromatographic Separations" - Analytical Chemistry By Open Learning, Peter A. Sewell, Brian Clarke, David Kealey, John Wiley & Sons Ltd, 1988
18.3.16. "Quantitative analysis using chromatographic techniques" - Analytical Chemistry By Open Learning, Elena Katz, John Wiley & Sons Ltd, 1987
18.3.17. "Mass Spectrometry – Analytical Chemistry by open Learning" - 2nd edition, James Barker, John Wiley & Sons Ltd, University of Greenwich, 1999
18.3.18. "Controlled Substances Training Manual", Virginia Department of Forensic Science, DFS Document 221-D200, Revision 1, February 2009
18.3.19. ENFSI DWG Mass Spectral Library
18.3.20. "Instrumental Data for Drug Analysis", Terry Mills III and J.Conrad Robertson, second edition,1993
18.3.21. "Controlled Substances Procedures Manual", Virginia Department of Forensic Science, DFS Document 221-D100, Revision 8, Augusta 2012
18.3.22. "Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", United Nations Office on Drugs and Crime, 2011 (link updated oct. 2012)
18.3.23. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.
18.3.24. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009

18.3.25. GC instrumental manuals of laboratory.
18.3.26. GC/MS instrumental manuals of laboratory

18.4. Assessment

18.4.1. Study questions (oral, written)
18.4.2. Preparation and GC and GC/MS qualitative analysis of unknown samples (practical)
18.4.3. Preparation and GC and GC/MS quantitative analysis of unknown samples (practical)
18.4.4. Courtroom exercise (mini-mock trial)

19. Gas Chromatography/Mass Spectrometry (GC/MS)

19.1. Objectives

19.1.1. Learn the theory of gas chromatography/mass spectrometry (GC/MS)

19.1.1.1. Awareness of the mechanism of separations, including support materials, stationary phases, carrier gas and operating temperature, and relevant criteria
19.1.1.2. Familiarity with the various instrumental components and their functions, including injection port, column and detectors (FID, NPD, ECD, MS)
19.1.1.3. Familiarity with the MS components and their functions, including sample inlet, ionisation, ion separation, ion detection and amplification, output of results
19.1.1.4. Knowledge of the theory and mechanism of GC/MS as an identification technique, fragmentation process and spectra interpretation
19.1.1.5. Knowledge of derivatisation techniques, advantages and disadvantages

19.1.1.6. Knowledge of qualitative and quantitative determinations using GC
19.1.1.7. Awareness of common operational problems and causes, pitfalls and troubleshooting, preventive maintenance
19.1.1.8. Knowledge of concept of quality assurance and method validation

19.1.2. Ability in the application of GC and GC/MS in drug analysis

19.1.2.1. Ability to prepare samples and avoid cross contamination
19.1.2.2. Familiarity with/practice in the GC instrumentation and software
19.1.2.3. Familiarity with/practice in the GC/MS instrumentation and software
19.1.2.4. Familiarity with the operational procedures, including control of instrument
19.1.2.5. Knowledge of choice criteria and ability to determine suitable conditions and to design experiments aiming at optimum separations
19.1.2.6. Practice in the application of GC and GC/MS methodology for qualitative and quantitative analysis of drugs most commonly encountered

19.1.3. Capacity of interpretation of the results obtained. Ability to perform library search (GC/MS) and interpret spectra
19.1.4. Understanding the possibilities and limitations of the technique
19.1.5. Become familiar with Agilent ChemStation® software and features of the MS including parametric retrieval, library searches, and ion extraction

19.2. Modes of Instruction

19.2.1. Self-directed study through recommended reading
19.2.2. (Clarification of questions)
19.2.3. Demonstrations by trainer: execution of GC and GC/MS analysis, with explanations
19.2.4. Interpretation of results and discussion
19.2.5. Application of GC and GC/MS on reference/known samples by trainee
19.2.6. Application of GC and GC/MS on unknown samples by trainee, qualitative and quantitative determination
19.2.7. Discussion

19.3. References

19.3.1. Moffat, A.C., editor. *Clarke's Isolation and Identification of Drugs.* London: The Pharmaceutical Press, 1986, pp. 251-263.
19.3.2. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.
19.3.3. *Basic Training Program for Forensic Chemists*, US Department of Justice, Drug Enforcement Administration, Office of Science and Technology, pp, 5-61 through 5-72.
19.3.4. Austin Police Department, "Systematic Analysis of Drug – GC/MS" (?)
19.3.5. Saferstein, Richard. "Forensic Applications of Mass Spectrometry". *Forensic Science Handbook, Volume I*. Englewood Cliffs, N.J.: Prentice hall, 1982, pp. 92-138.
19.3.6. Agilent MS instrument manuals
19.3.7. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.
19.3.8. "Gas Chromatography" - Analytical Chemistry by Open Learning, Ian A. Fowlis, (Paperback), John Wiley & Sons Ltd, Baffins Lane, Chichester, West Sussex P019, England, 1999
19.3.9. "A Practical Guide to the Care, Maintenance and Troubleshooting of Capillary Gas Chromatographic Systems", Rood, Dean, Wiley-VCH, New York, 1999

19.3.10. "Modern Practice of Gas Chromatography", Grob RL and Barry EF, New York , Wiley-Interscience; 3rd Ed., 1995
19.3.11. "Split and Splitless Injection for Quantitative Gas Chromatography, Concepts, Process, Practical Guidelines, Sources of Error", Grob K, Wiley-VCH, 4th Ed., 2001
19.3.12. "Gas Chromatography", Prichard E and Stuart B, Royal Society of Chemistry, 2003
19.3.13. "Derivatisation Techniques for Gas Chromatography, Chromatography Today", Poole CF, Poole SK, Elsevier, 1991
19.3.14. "Mass Spectrometry – Principles and Applications", Hoffmann, E.de & Stroobant, V., editor, England, Wiley, 2001
19.3.15. "Advances in Forensic Applications of Mass Spectrometry", Yinon J, 2004
19.3.16. "Chromatographic Separations" - Analytical Chemistry By Open Learning, Peter A. Sewell, Brian Clarke, David Kealey, John Wiley & Sons Ltd, 1988
19.3.17. "Quantitative analysis using chromatographic techniques" - Analytical Chemistry By Open Learning, Elena Katz, John Wiley & Sons Ltd, 1987
19.3.18. "Mass Spectrometry – Analytical Chemistry by open Learning" - 2nd edition, James Barker, John Wiley & Sons Ltd, University of Greenwich, 1999
19.3.19. ENFSI DWG Mass Spectral Library
19.3.20. "Instrumental Data for Drug Analysis", Terry Mills III and J.Conrad Robertson, second edition,1993
19.3.21. "Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", United Nations Office on Drugs and Crime, 2011 (link updated oct. 2012)
19.3.22. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.
19.3.23. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009
19.3.24. GC instrumental manuals of laboratory.
19.3.25. GC/MS instrumental manuals of laboratory

19.4. Assessment

19.4.1. Study questions (oral, written)
19.4.2. Preparation and GC and GC/MS qualitative analysis of unknown samples (practical)
19.4.3. Preparation and GC and GC/MS quantitative analysis of unknown samples (practical)
19.4.4. Courtroom exercise (mini-mock trial)

20. High Performance Liquid Chromatography including Liquid Chromatography/Mass Spectrometry (LC/MS)

20.1. Objectives

20.1.1. Knowledge of the principle/theory of HPLC including LC/MS in drug analysis

20.1.1.1. Knowledge of the mechanism of separations, including stationary phases (columns, criteria of choice), mobile phase (types, uses, composition) and temperature

20.1.1.2. Familiarity with the various instrumental components and their functions including injections port, column and detector (DAD, MS).
20.1.1.3. Familiarity with the MS components and their functions, including sample inlet, ionisation, ion separation, ion detection and amplification, output of results
20.1.1.4. Awareness of the mechanism of HPLC incl. LC/MS as an identification technique
20.1.1.5. Qualitative and quantitative determinations using HPLC and LC/MS
20.1.1.6. Awareness of common operational problems and causes, pitfalls and troubleshooting, preventive maintenance
20.1.1.7. Knowledge of quality assurance and method validation requirements

20.1.2. Knowledge of the application of HPLC and LC/MS in drug analysis

20.1.2.1. Familiarity with the HPLC and LC/MS instrumentation and software
20.1.2.2. Familiarity with the operational procedures including control of instrument
20.1.2.3. Ability to design experiments aiming at selecting operating conditions for optimum separations
20.1.2.4. Practice in the application of HPLC and LC/MS methodology in the qualitative and quantitative analysis of drugs most commonly encountered

20.1.3. Capacity of understanding and interpretation of the results obtained
20.1.4. Ability to perform library search (LC/MS) and interpret spectra
20.1.5. Become familiar with Waters Empower® software and features of the LC
20.1.6. Understanding the possibilities and limitations of the technique

20.2. Modes of Instruction

20.2.1. Self-directed study through recommended reading
20.2.2. (Clarification of questions)
20.2.3. Demonstrations by trainer: execution of HPLC and LC/MS analysis, with explanations
20.2.4. Interpretation of results and discussion
20.2.5. Application of HPLC and LC/MS on reference/known samples by trainee
20.2.6. Application of HPLC and LC/MS on unknown samples by trainee, qualitative and quantitative determination
20.2.7. Discussion

20.3. References

20.3.1. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

20.3.2. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

20.3.3. "High Performance Liquid Chromatography" - Analytical Chemistry by Open Learning, 2nd Edition, S.Lindsay, John Wiley & Sons, Chichester, West Sussex, U.K., 1992,ISBN 0-471-93115-2 (paperback)

20.3.4. "High-Performance Liquid Chromatography in Forensic Chemistry", Lurie IS, 1983

20.3.5. "Liquid Chromatography/Mass Spectrometry – Application in Agricultural, Pharmaceutical, and Environmental Chemistry", Mark A. Brown, Editor, American Chemical Society, Washington DC, 1990

20.3.6. "Chromatographic Separations" - Analytical Chemistry By Open Learning Peter A. Sewell, Brian Clarke, David Kealey, John Wiley & Sons Ltd, 1988

20.3.7. "Quantitative analysis using chromatographic techniques" - Analytical Chemistry By Open Learning, Elena Katz, John Wiley & Sons Ltd, 1987

20.3.8. "Mass Spectrometry – Principles and Applications", Hoffmann, E.de & Stroobant, V., editor, England, Wiley, 2001

20.3.9. "Mass Spectrometry" – Analytical Chemistry by open Learning - 2nd edition, James Barker, John Wiley & Sons, University of Greenwich, 1999

20.3.10. "Instrumental Data for Drug Analysis", Terry Mills III and J.Conrad Robertson, second edition,1993. – LC/MS

20.3.11. "Liquid Chromatography/Mass Spectrometry, Systems and Applications", W.H. Mc Fadden, J.Chromatogr. Sci., 1980, 18, 97-102

20.3.12. "'Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", UNODC, 2011 (link updated oct 2012)

20.3.13. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

20.3.14. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009

20.3.15. HPLC instrumental manuals of laboratory

20.3.16. LC/MS instrumental manuals of laboratory

20.3.17. Analysis of illicit diamorphine preparations by high-pressure liquid chromatography. Journal of Chromatography. 1975, 104(1), 205-10.

20.4. Assessment

20.4.1. Perform analysis of known samples (Practical)
20.4.2. Perform quantitation of known samples (Practical)
20.4.3. Perform extraction and analysis of unknown samples (Practical)
20.4.4. Written examination

21. Ultraviolet/Visible Spectroscopy (UV/VIS)

21.1. Objectives

21.1.1. Learn the theory of UV/VIS spectrophotometry in drug analysis

21.1.1.1. Theory and mechanism of molecular light absorption and electronic transitions. Awareness of the electromagnetic spectrum.
21.1.1.2. Parameters that define electromagnetic radiation (frequency, wavelength, wavenumber)
21.1.1.3. Laws of absorption : The Beer-Lambert Law
21.1.1.4. Mechanism of UV/VIS as an identification technique, including limitations
21.1.1.5. The influence of solvents and PH on spectra (wavelength maxima and band intensities)
21.1.1.6. Mechanism of UV/VIS as an quantitation technique (basic laws, single components, multi-component systems, colourimetric measurements, difference spectrophotometry, derivative spectrophotometry)
21.1.1.7. Knowledge of quality assurance and method validation requirements

21.1.2. Knowledge of the application of UV/VIS in drug analysis

21.1.2.1. Instrumentation (colourimeters, single-beam spectrophotometers, double-beam spectrophotometers, rapid-scanning spectrophotometers, absorption cells)
21.1.2.2. Preparation and handling of various kinds of samples
21.1.2.3. Application of UV/VIS methodology in the qualitative analysis of drugs
21.1.2.4. Application of UV/VIS methodology in the quantitative analysis of drugs
21.1.2.5. Awareness of common operational problems and causes, troubleshooting, preventive maintenance

21.1.3. Familiarity with the UV/VIS instrumentation and software
21.1.4. Familiarity with the operational procedures
21.1.5. Ability to select operating parameters aiming at best results
21.1.6. Practice in the application of UV/VIS methodology in the analysis of drugs most commonly encountered
21.1.7. Understanding the advantages and limitations of the technique
21.1.8. Capacity of interpretation of the results obtained
21.1.9. Experience in quantitative UV/VIS analysis
21.1.10. Become familiar with Varian Cary® software and features
21.1.11. Become familiar with sources for identification such as Clarke and Mills
21.1.12. Learn how contaminants can affect UV analysis
21.1.13. Learn extraction techniques for UV analysis
21.1.14. Learn the application of UV analysis for quantitation

21.2. Modes of Instruction

21.2.1. Self-directed study through recommended reading
21.2.2. (Clarification of questions)
21.2.3. Demonstrations by trainer: execution of UV/VIS analysis, with explanations
21.2.4. Interpretation of results and discussion
21.2.5. Application of UV/VIS on reference/known samples by trainee
21.2.6. Application of UV/VIS on unknown samples by trainee, qualitative and quantitative determination
21.2.7. Discussion

21.3. References

21.3.1. UV/Vis Absorption Spectroscopy Tutorial
http://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/uvvisab3.htm

21.3.2. Visible and UV Spectroscopy
http://www.cem.msu.edu/~reusch/VirtualText/Spectrpy/UV-Vis/spectrum.htm

21.3.3. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

21.3.4. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

21.3.5. "Ultraviolet and Visible Spectroscopy": Analytical Chemistry by Open Learning, Thomas MJK and Ando DJ, John Wiley & Sons; 2nd edition, 1996

21.3.6. "UV Spectroscopy, Techniques, Instrumentation and Data Handling", Clark BJ, Frost T and Russell MA, Springer, 1993

21.3.7. "Spectrometric Identification of Organic Compounds", Silverstein RM, Webster FX and Kiemle D, 7th Ed., New York, Wiley, 2005

21.3.8. "Instrumental Data for Drug Analysis", Terry Mills III and J.Conrad Robertson, second edition,1993.

21.3.9. "'Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", UNODC, 2011 (link updated oct. 2012)

21.3.10. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

21.3.11. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009

21.3.12. UV/VIS instrumental manuals of laboratory

21.4. Assessment

21.4.1. Study questions (oral, written)
21.4.2. Sample preparation and UV/VIS qualitative analysis of unknown samples (practical)
21.4.3. Sample preparation and UV/VIS quantitative analysis of unknown samples (practical)
21.4.4. Courtroom exercise (mini-mock trial)

22. Infrared Spectroscopy (FTIR)

22.1. Objectives

22.1.1. Learn the theory of FTIR in drug analysis

22.1.1.1. Knowledge of the electromagnetic spectrum
22.1.1.2. Knowledge of the theory and mechanism of absorption and of vibrational and rotational spectroscopy
22.1.1.3. The Beer-Lambert Law
22.1.1.4. Knowledge of the mechanism of IR as an identification technique, (characteristic IR group frequencies and structure/spectra correlations)
22.1.1.5. Fourier transform infrared spectroscopy (FTIR) and the different techniques (KBr, ATR etc)
22.1.1.6. Familiarity with the various instrumental components and their functions
22.1.1.7. Awareness of common operational problems and causes, troubleshooting, preventive maintenance

22.1.1.8. Knowledge of quality assurance and method validation requirements

22.1.2. Knowledge of the application of IR in drug analysis

22.1.2.1. Familiarity with the (FT)IR instrumentation and software (dispersive and interferometric spectrophotometers, data processing)
22.1.2.2. Familiarity with the operational procedures (sample purification and preparation, identification and interpretation of spectra)
22.1.2.3. Practice in the application of IR methodology in the qualitative and quantitative analysis of drugs most commonly encountered
22.1.2.4. Proper use of spectral manipulations (e.g. subtraction, baseline correction, library searching)
22.1.2.5. Learn techniques associated with FTIR analysis, e.g. DRIFTS, ATR, KBr pellets

22.1.3. Ability to select operating parameters aiming at best results
22.1.4. Practice in the preparation and handling of various kinds of samples
22.1.5. Practice in the application of IR methodology in the analysis of drugs most commonly encountered
22.1.6. Understanding the advantages and limitations of the technique
22.1.7. Capacity of interpretation of the results obtained
22.1.8. Experience in quantitative IR analysis
22.1.9. Become familiar with Thermo-Nicolet OMNIC® software and features including baseline subtraction, library searching, data storage, and printing options
22.1.10. Become familiar with sources for identification such as Clarke and Mills
22.1.11. Learn extraction techniques for FTIR analysis

22.2. Modes of Instruction

22.2.1. Self-directed study through recommended reading
22.2.2. (Clarification of questions)
22.2.3. Demonstrations by trainer: execution of FTIR analysis, with explanations
22.2.4. Interpretation of results and discussion
22.2.5. Application of FTIR on reference/known samples by trainee
22.2.6. Application of FTIR on unknown samples by trainee, qualitative and quantitative determination
22.2.7. Discussion

22.3. References

22.3.1. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

22.3.2. Moffat. A.C., et al., editors. *Clarke's Analysis of Drugs and Poisons*. London: The Pharmaceutical Press, 1986.

22.3.3. Thermo Nicolet Instrument Manuals

22.3.4. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

22.3.5. *Basic Training Program for Forensic Chemists,* U.S. Department of Justice, Drug Enforcement Administration, Office of Science and Technology, pp. 5-17 through 5-29.

22.3.6. "Introduction to FTIR and Raman", Vibrational Spectroscopy, Varian Inc., Randolph, MA.

22.3.7. "Infrared Spectroscopy – Analytical Chemistry by Open Learning" W.O. George, P.S. Mcintyre, Editor: David J. Mowthorpe, John Wiley &Sons 1987

22.3.8. "Fundamental of Fourier Transform Infrared Spectroscopy, Brian C. Smith, CRC Press, 1996

22.3.9. British Pharmacopoeia 2007, British Pharmacopoeia Commission, 2006

22.3.10. "IR Spectroscopy: An Introduction", Günzler H and Gremlich HU, Wiley-VCH; 1st Ed., 2002

22.3.11. "Handbook of Fourier Transform Raman and Infrared Spectra of Polymers", Kuptsov AH and Zhizhin GN, Elsevier Science, 1998

22.3.12. "Infrared Spectroscopy: Fundamentals and Applications (Analytical Techniques in the Sciences)", Stuart BH, John Wiley & Sons, 2004

22.3.13. "Controlled Substances Training Manual", Virginia Department of Forensic Science, DFS Document 221-D200, Revision 1, February 2009

22.3.14. "Controlled Substances Procedures Manual", Virginia Department of Forensic Science, DFS Document 221-D100, Revision 8, August 2012

22.3.15. "Instrumental Data for Drug Analysis", Terry Mills III and J.Conrad Robertson, second edition,1993.

22.3.16. "Staff Skill Requirements and Equipment Recommendations for Forensic Science Laboratories", UNODC, 2011 (link updated to last revision of document - oct. 2012)

22.3.17. United Nations Office on Drugs and Crime. (2009). *Guidelines on representative drug sampling* (UNODC & ENFSI DWG, ST/NAR/38). Vienna, Austria: Vienna International Centre.

22.3.18. "Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens - ST/NAR/41", UNODC, 2009

22.3.19. IR instrumental manuals of laboratory

22.4. Assessment

22.4.1. Study questions (oral, written)

22.4.2. Sample preparation and IR qualitative analysis of known samples (practical)

22.4.3. Sample preparation and IR quantitative analysis of unknown samples (practical)

22.4.4. Courtroom exercise (mini-mock trial)

23. Separations and Extractions

23.1. Objectives

23.1.1. Knowledge of the principle/theory of Separations and Extractions in drug analysis

23.1.1.1. Awareness of the factors which affect separations
23.1.1.2. Knowledge of the criteria for selection of solvent systems, including safety and cost
23.1.1.3. Familiarity with extraction techniques
23.1.1.4. Awareness of possible problems and likely causes/solutions
23.1.1.5. Use of solubility to separate mixtures of drugs and diluents
23.1.1.6. Definition of pKa and the Henderson Hasselbach equation
23.1.1.7. Basic drug extractions using aqueous/organic solvents
23.1.1.8. Acidic drug extractions using aqueous/organic solvents
23.1.1.9. Amphoteric drug extractions using aqueous/organic solvents
23.1.1.10. Neutral drug extractions using aqueous/organic solvents
23.1.1.11. Specialty (difficult) type extractions

23.1.2. Knowledge of the application of Solid Phase extraction (SPE) in drug analysis

23.1.3. Knowledge of chromatographic separation techniques

23.1.3.1. Use of preparative column
23.1.3.2. Use of Silica and Flurosil columns
23.1.3.3. Column preparation, loading and eluting

23.1.4. Knowledge of the possibilities and limitations of the technique
23.1.5. Learn the acid/base properties of drugs
23.1.6. Learn different extraction and separation methods

23.2. Modes of Instruction

23.2.1. Self-directed study through recommended reading
23.2.2. (Clarification of questions)
23.2.3. Preparation of different extraction solvent reagents including review of safety precautions
23.2.4. Demonstrations by trainer: execution of extraction techniques, with explanations
23.2.5. Interpretation of results and discussion
23.2.6. Application of extractions on reference/known samples by trainee
23.2.7. Application of extractions on unknown samples by trainee
23.2.8. Discussion

23.3. References

23.3.1. Moffat, A.C., editor. Clarke's Isolation and Identification of Drugs. London: The Pharmaceutical Press, 1986.

23.3.2. Clarke, E.G.C., Isolation and Identification of Drugs, London: The Pharmaceutical Press, 1972, Vol. 1, 2.

23.3.3. Higuchi, T. et al. "Ion Pair Extraction of Pharmaceutical Amines" *Analytical Chemistry,* Vol. 39, 1967, p. 974.

23.3.4. Watson, D.G. *Pharmaceutical Analysis* New York: Churchill Livingstone, 1999, pp. 17-47.

23.3.5. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

23.3.6. Clarke, E. G. C. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids, and Postmortem Material* (3rd ed., Vol. 1-2). A. C. Moffat, Osselton, M. D., & Widdop, B. (Eds.) Grayslake, IL: Pharmaceutical Press.

23.3.7. "A Textbook of Pharmaceutical Analysis", 3rd Edition Connors, K. A., ,

23.3.8. John Wiley, New York, 1982, pp. 341-350.

23.3.9. Modern Methods of Pharmaceutical Analysis Schirmer, Roger E., ,

23.3.10. Vol. 1, CRC Press, Boca Raton, Florida, 1982, pp. 1-29.

23.3.11. The Systematic Identification of Organic Compounds, 6th Edition, Shriner, R. L., Fuson, R. C., Curtin, D. Y., and Morrill, T. C., 1980,pp. 371-373.

23.3.12. Theory and Practice in the Organic Laboratory, 3rd Edition, Landgrebe, J., D. C. Heath & Co., Lexington, Massachusetts, 1982, pp. 78-86.

23.3.13. Martindale The Extra Pharmacopoeia, 36th Ed., Reynolds, James, E. F., Ed., The Pharmaceutical Press, London, 1989. General reference

23.3.14. The Merck Index, 14th or Current Edition, Budavari, Susan, Ed., Merck and Co., Inc., General reference.

23.4. Assessment

23.4.1. Study questions (oral, written)
23.4.2. Sample preparation and separation of known samples (practical)
23.4.3. Sample preparation and separation of unknown samples (practical)
23.4.4. Courtroom exercise (mini-mock trial)

Clandestine Laboratory Field Investigations

24. Common Clandestine Laboratories

24.1. Objectives

24.1.1. Become familiar with common clandestine laboratory synthesis methods
24.1.2. Knowledge of the substances used in the clandestine production/manufacture of narcotic drugs and psychotropic substances
24.1.3. Knowledge of the production/manufacture of controlled substances
24.1.4. Knowledge of the investigation and dismantling of clandestine laboratories

24.2. Modes of Instruction

24.2.1. Self-directed study through recommended reading
24.2.2. Accompany chemist at laboratory sites to observe functions
24.2.3. Practical exercise on investigation, risk assessment, risk management, processing of the laboratory, registration, documenting, sampling, disposal
24.2.4. Discussion

24.3. References

24.3.1. Forensic Division Safety Manual safety guidelines for investigating and dismantling a clandestine lab

24.3.2. Weaver, K. and Yeung, E. An Analyst's Guide to the Investigation of Clandestine Laboratories, 3rd edition. Health Protection Branch, Ontario Region Health Canada, 1995.

24.3.3. Clandestine Lab Basic Guide, presented at the 12th Annual Clandestine Laboratory Investigating Chemists Training Seminar, 2002.

24.3.4. Ely, Roger, et al. A Review of the Syntheses and Analyses of Phenyl-2-propanone, Amphetamine, and Methamphetamine. Clandestine Laboratory Investigating Chemists, 1995.

24.3.5. Clandestine Laboratory Investigating Chemists monographs.

24.3.6. Strike. Total Synthesis II, San Antonio, TX: Panda Ink, 1999.

24.3.7. Uncle Fester. Advanced Techniques of Clandestine Psychedelic & Amphetamine Manufacture. Port Townsend, WA: Loompanics Unlimited, 1988.

24.3.8. "Understanding clandestine synthetic drugs", UNODC, June 2001

24.3.9. "Data Sheets on Substances Frequently Used in the Illicit Manufacture of Narcotic Drugs or Psychotropic Substances", SCITEC/9/REV.2, 2009 (in preparation)

24.3.10. "Clandestine Manufacture of Substances under International Control", UNODC, ST/NAR/10/Rev.2, August 1998

24.3.11. "Guidelines for the Safe Handling and Disposal of Chemicals Used in the Illicit Manufacture of Drugs", ST/NAR/36 rev.1, UNODC, 2011.

24.3.12. “Clandestine Laboratory Guide for Agents and Chemists”, United States Department of Justice, Drug Enforcement Administration, Office of Forensic Sciences

24.3.13. “Chemicals used in the Clandestine Production of Drugs”, US Department of Justice, Drug Enforcement Administration, Office of Diversion Control, Drug and Chemical Evaluation Section

24.3.14. Canaff, R. (1972). *Basic Training Program for Forensic Drug Chemists*. Washington, DC: U.S. Department of Justice Bureau of Narcotics and Dangerous Drugs.

24.3.15. “DRCHIS: Drugs geRelateerd CHemicalien Informatie Systeem”, A. Elissen, M.L. Hordijk, Dutch National Criminal Intelligence Division, May 1999

24.3.16. “Manual on the production of Synthetic Drugs”, Europol, The Hague, July 1999

24.3.17. “European Union Training Course for Trainers on the combating of Illicit Synthetic Drugs Laboratories, Course Standard”, Europol, The Hague, 1999

24.3.18. “Forensic Investigation of Clandestine Laboratories”, Donnell RC, CRC Press, 2004.

24.3.19. “Advanced Techniques of Clandestine Psychedelic and Amphetamine Manufacture”, Uncle Fenster, Loompanics Unlimited, 1998.

24.4. Assessment

24.4.1. Study questions

24.4.2. Practical exercise in a simulated environment of a clandestine laboratory : Investigation, risk assessment, risk management, processing of the laboratory, registration, documenting, sampling

24.4.3. Courtroom exercise (mini-mock trial)

Legislation

Courtroom Testimony

25. Courtroom Testimony (ISO 5.2.1.2, and 5.2.1.3)

25.1. Objectives

25.1.1. Become familiar with the functions of a courtroom criminal proceeding (ISO 5.2.1.3)
25.1.2. Become familiar with relevant court decisions, e.g. Daubert, Frye, etc.
25.1.3. Learn the court structure (municipal court, juvenile court, district court, federal court)
25.1.4. Prepare current curriculum vitae and convey voir dire questioning during testimony
25.1.5. Become familiar with proper methods of presenting expert testimony during direct examination
25.1.6. Become familiar with proper methods of defending analytical results during cross-examination
25.1.7. Item chain of custody and method of identifying item in court. (ISO 5.2.1.2)

25.2. Modes of Instruction

25.2.1. Self-directed study through recommended reading
25.2.2. (Clarification of questions)
25.2.3. Presentation of case studies and demonstrations
25.2.4. Direct observation of expert testmony
25.2.5. Practical exercises
25.2.6. Discussion

25.3. References

25.3.1. “Interpreting Evidence - Evaluating Forensic Science in the Courtroom”, Robertson B, Vignaux GA, John Wiley & Sons, Chichester, West Sussex

25.3.2. Kuzmack, Nicholas T., J.D., M.A. “Legal Aspects of Forensic Science”, in Saferstein, Richard, Ph.D., editor. Forensic Science Handbook. Englewood Cliffs, N.J.: Prentice Hall, 1982, pp. 1-27.

25.3.3. Houck & Siegel

25.3.4. Shellow, James M. “The Expert Witness in Narcotics Cases”, in Contemporary Drug Problems, - A Law Quarterly, Sprint 1973, pp. 81-104.

25.3.5. Travnikoff, Basil, Jr. and Kvick, Robert J. How to Examine a Chemist in Drug Abuse Cases, First Edition, 1971.

25.3.6. Bailey, F.L. and Rothblatt, H.B., Handling Narcotics and Drug Cases, Rochester, NY: The Lawyers Cooperative Publishing Co., 1972.

25.3.7. http://www.ncids.com/forensic/metrology/uncertainty.shtml [EDIT]

25.3.8. People v. Jabrocki (from above link) [EDIT]ttorney asks, “Is it

25.3.9. State v. Fausto (from above link) [EDIT]

25.3.10. State v. Weimer (from above link) [EDIT]

25.3.11. City of Kent v. McDaniel (from above link) [EDIT]

25.4. Assessment

25.4.1. Study questions
25.4.2. Formal mock trial

Forensic Chemistry Drug Training Manual Updates			
	Date	Description of Update	Page(s)
1.	11/15/2012	Objectives were clarified, sections were added	All